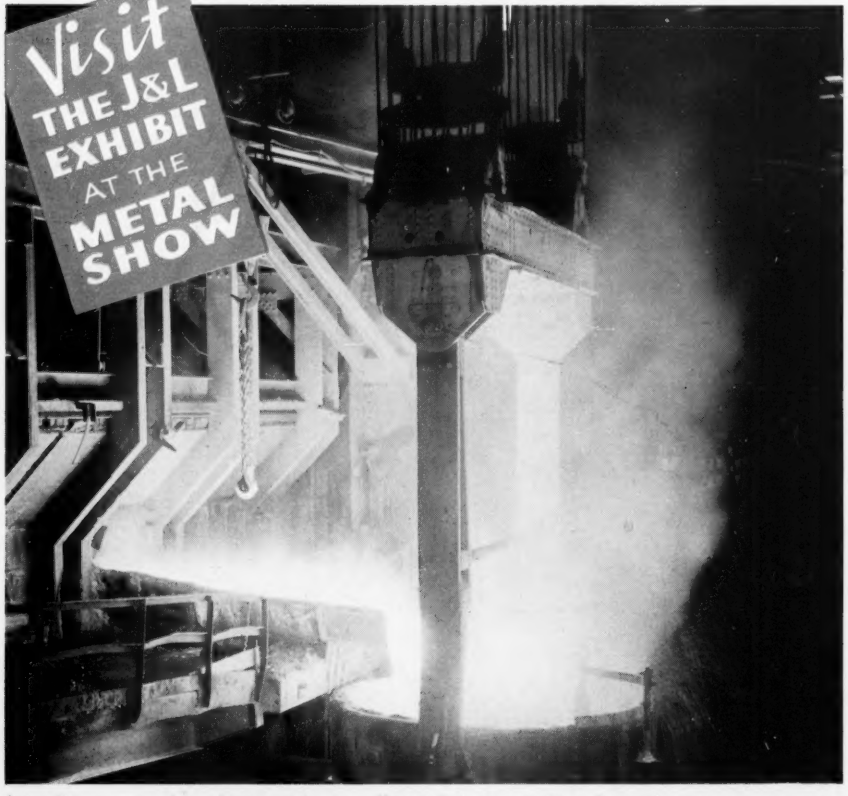
WIRE

OCTOBER 1941

AND WIRE PRODUCTS

Are you getting MAXIMUM YIELD AND PRODUCTION WITH THE STEEL WIRE you are using?



J&L mills are at peak production and every effort is being exerted to adequately serve our customers.

Our aim in this national defense emergency is to help our customers get the most out-put from the J&L manufacturers' wire they use. This means that our metallurgists are constantly on the go, practically living in customers' plants, helping with their problems, making suggestions, assisting them in every way possible to get maximum yield from their operations.

By doing this we believe we help in a measure to spread the facilities and services of our own mills, even though they are now in production to the hilt.

We do know from experience that by cooperating with your sources of supply greater yield and greater satisfaction is the result all the way around.

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS • PITTSBURGH, PENNSYLVANIA

MASTERCRAFT SPRING WIRE
ELECTROMATIC OIL-TEMPERED SPRING WIRE
COLD HEADING WIRE • BRIGHT BASIC WIRE

J&L STEEL

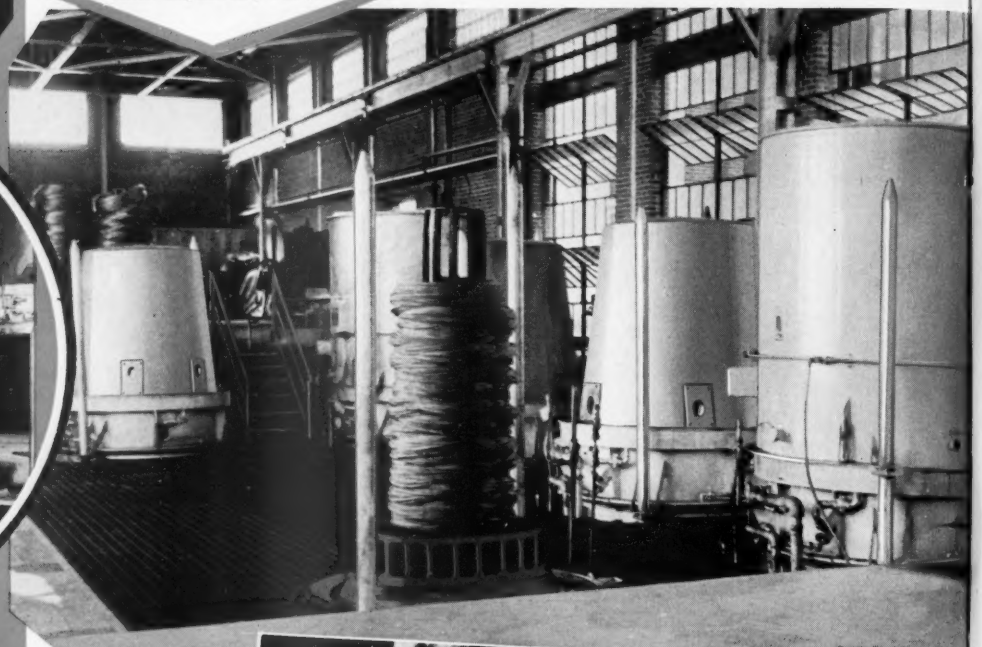
OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

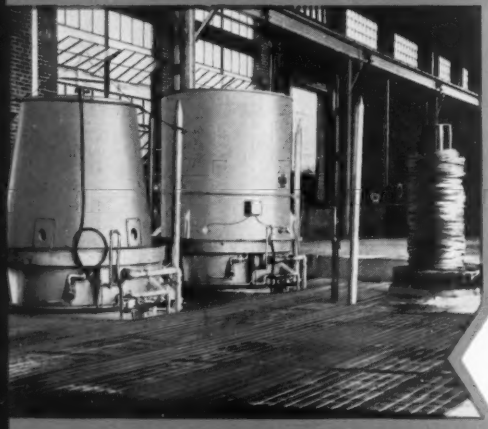
Atlantic Wire Company bright anneals fine wire for many purposes . . . .

WITH WILSON RETORT TYPE Furnaces

Recently completed installation of 2 Furnaces and 6 Bases at Atlantic Wire Company, Branford, Conn., completely engineered by the Lee Wilson Engineering Company.

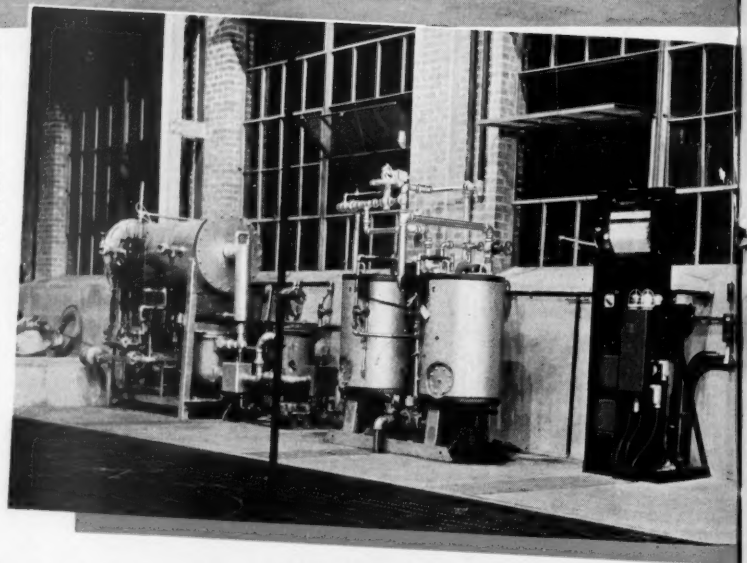
The retort is lifted.



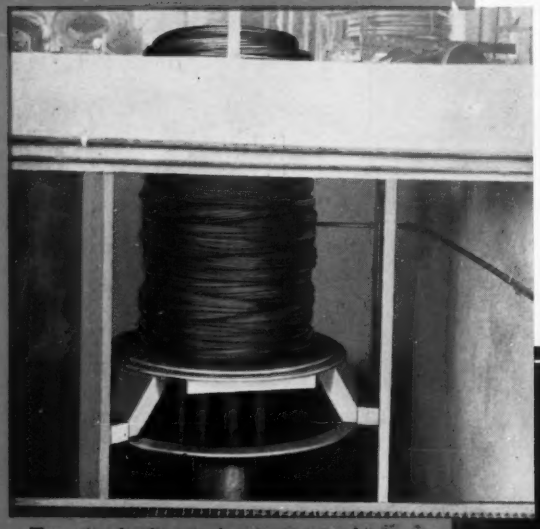


The annealing charge is finished.

• The Wilson Annealing Unit is covered by Patents Numbers 1952402, 2068477, 2078356, 2081612, 2089843, and other patents pending.



Temperature control p and deoxidizing gas ge ing equipment. All operating floor level.



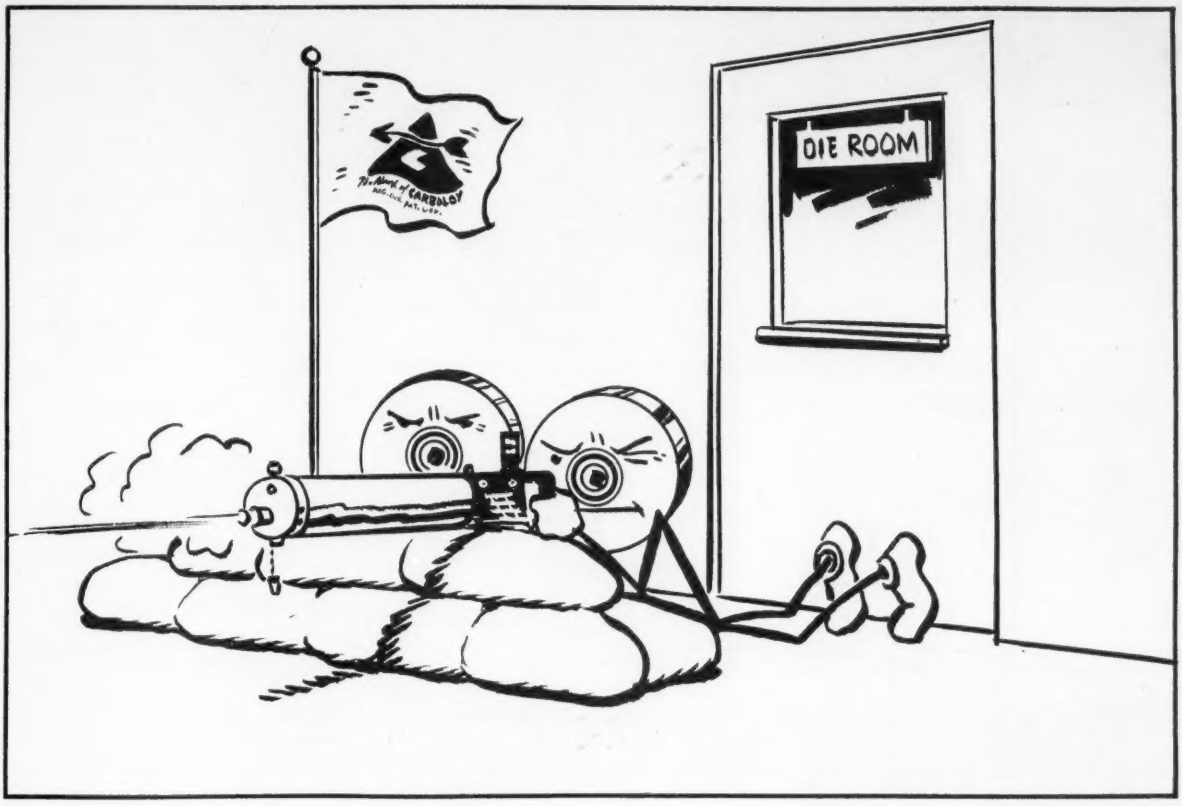
The wire loading and stripping machine

With typical thoroughness Billy Hitchcock planned an entirely new annealing department in an entirely new annealing building, with the most modern equipment available. Today this new unit, which expanded the annealing capacity, is operating more than 50% on defense production.

An Exclusive Development of

LEE WILSON ENGINEERING CO.

1370 Blount Street • Cleveland, Ohio



DEFENSE . . . *for Die Rooms!*

With mill production stepped up to present day peaks, abnormal loads on die room service facilities are not uncommon. Under such conditions it is often found that the number of dies being returned for re-servicing exceeds the output of the die room and a "jam" soon occurs that delays production.

Since in most mills a considerable period of years has passed since the original installation of a special die room system for handling carbide dies, a review of present carbide die service technique and handling methods often provides immediate relief for overloaded die rooms. In one recent case a review of this kind made it possible to quickly eliminate the "line-up" at the die window, build up substantial inventories of re-serviced dies in the main die rack, and eliminate all hurried, improvised servicing formerly necessary just to keep the mill running.

Our Carboloy Die-Service men will be glad to assist *your* die room men in this activity too.

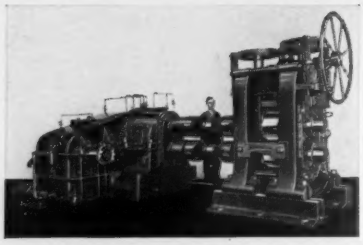
CARBOLOY COMPANY, INC., DETROIT, MICHIGAN

CHICAGO · CLEVELAND · NEWARK · LOS ANGELES · PITTSBURGH · PHILADELPHIA · WORCESTER, MASS.

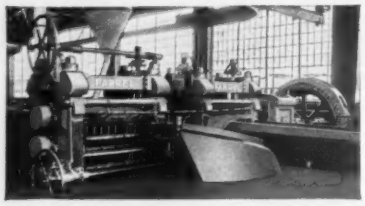
Authorized Distributors: Canadian General Electric Co., Ltd., Toronto, Canada · Hartley Wire Die Co., Thomaston, Conn.

VISIT BOOTH E-34, NATIONAL METAL EXPOSITION, OCT. 20-24, PHILADELPHIA

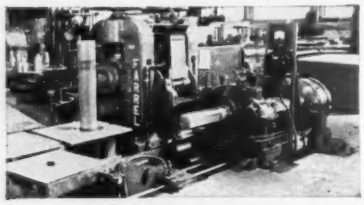
CARBOLOY REG. U.S. PAT. OFF. **DRAWING AND SIZING DIES**



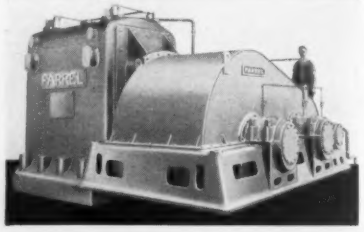
Farrel Rolling Mills are built in a wide range of sizes, designed for any specific purpose. Above is shown a 16″ x 16″ Two-High Mill designed especially for rolling copper nickel alloys.



We are prepared to design and install complete rod mills from furnace to coilers for any required output. Illustrated above are two 20″ x 60″ Three-High Breaking Down and Roughing Mills with feed table and repeater.



Farrel Constant Tension Reels are made in several types to fit specific requirements. Illustrated is a reel with jaw-type wrapper, stripper and up-ender installed on a brass finishing mill.



Farrel Gear Drives are made in any size and a variety of types. Shown above is a Double Reduction Gear Unit with integral 44″ Pinion Stand for 40″ x 168″ Reversing Mill.

FARREL PRODUCTION UNITS for ROLLING MILLS .. *combine*

Built-in Skill and Ruggedness for Sustained High Output with Precision

The machines illustrated are typical of Farrel Production Units for Rolling Mills built to meet today's urgent demand for sustained high production with uniform precision. Farrel Production Units have many improved features of design and construction which lead to higher operating efficiency, increased output, lower power consumption, minimum labor and maintenance costs and improved quality products.

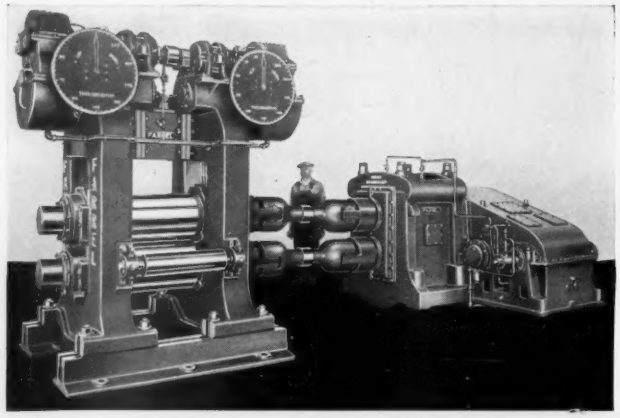
Farrel Cold Strip Mills are designed for high precision rolling of brass, copper, aluminum, duralumin and other non-ferrous metals and alloys. They are ruggedly built to take heavy passes at high speed and to do it continuously.

Farrel Rod Mills are designed especially to cut power costs and labor handling, to permit the rolling of a diversified product of high quality and to give sustained high output with minimum scrap.

Farrel Constant Tension Reels are designed to improve strip quality, increase mill output and reduce rolling cost. They provide constant tension under positive control from empty to full reel, keep the metal flat and straight and maintain uniform gauge.

Farrel Drives and Pinion Stands are precision built for smooth, quiet operation and designed to withstand the stresses, shocks and wear incident to the high speeds and heavy loads of modern mill practice.

Farrel Rolling Mill Equipment is designed and built to fit individual conditions of operation, and experienced engineers are available for consultation to assist in working out effective applications to special production requirements.



Typical of the modern features built into Farrel Rolling Mills is this 20″ x 32″ Two-High Cold Strip Mill designed for high precision rolling of non-ferrous metals, with heavy passes and high speed for maximum output.

Farrel Rolling Mill Equipment

Rolls—Rolling Mills—Rod Mill Tables and Manipulating Equipment—Universal Mill Spindles — Rod Coilers — Lead Presses for Pipe or Rod—Roll Grinding Machines—Roll Calipers—Gears — Mill Pinions — Pinion Stands — Gear Drives of any capacity—Flexible Couplings.

FARREL REG. U.S. PAT. OFF.

FARREL-BIRMINGHAM COMPANY, Inc.

ANSONIA, CONN.

New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

Now More Important Than Ever!

NORTON SERVICE

Local Stocks

In over 150 cities Norton distributors have grinding wheels on their shelves—service of stock wheels for the defense industries. Backing the distributor stocks are Norton branch warehouses in five industrial centers. Back of them are the immense stock rooms at Worcester and a factory organization geared to meet abnormal needs.

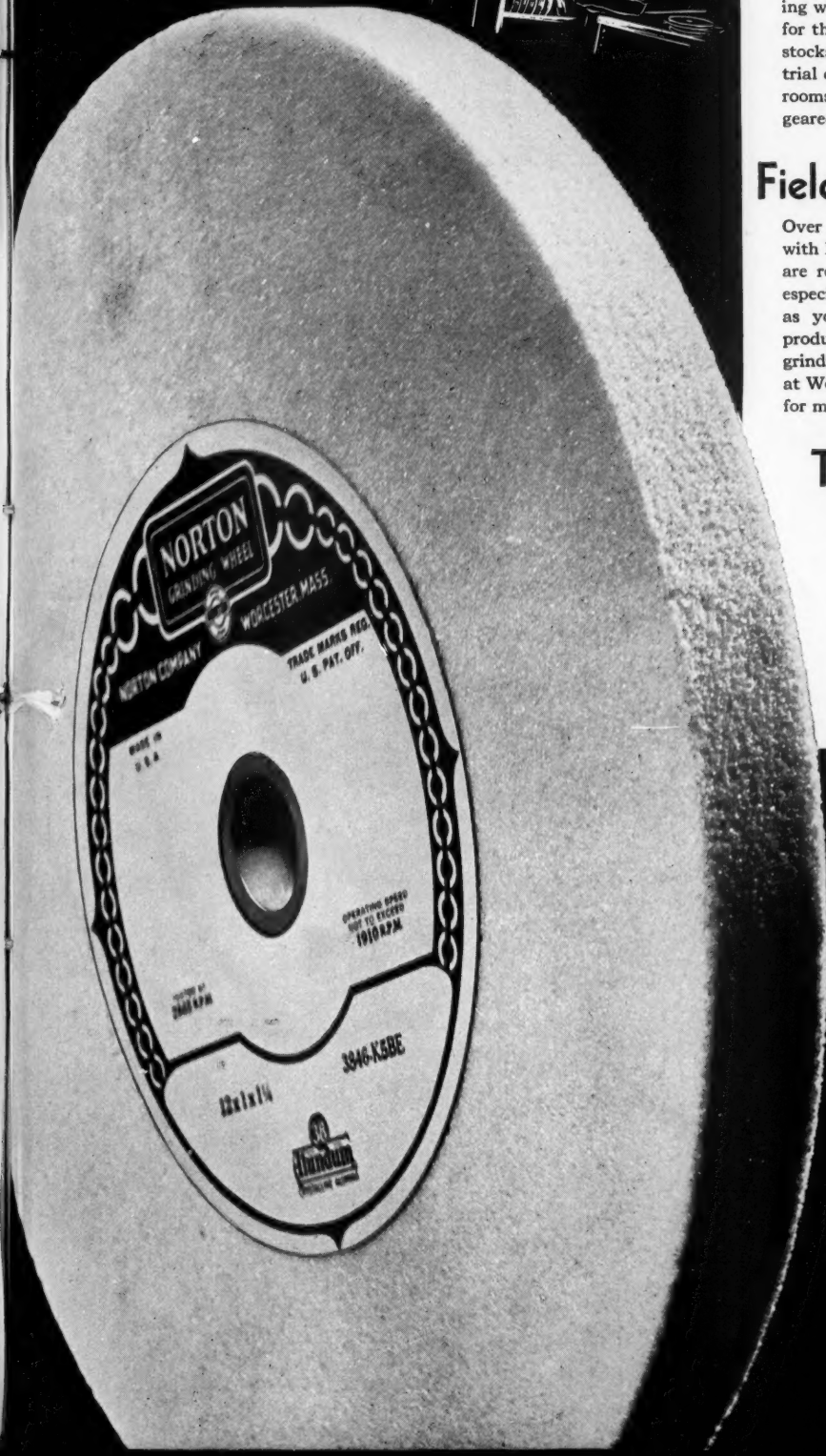
Field Staff

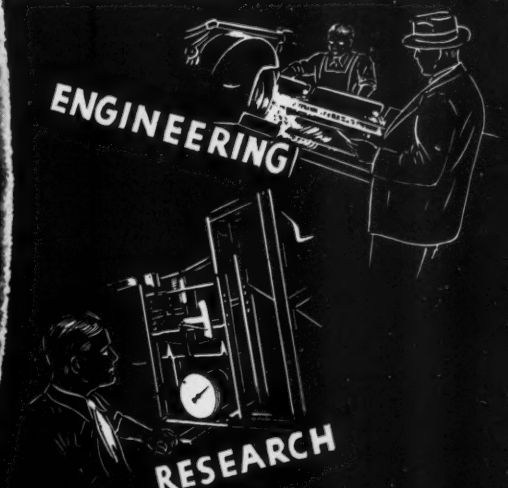
Over 1800 distributors' representatives, coöperating with Norton field engineers and factory specialists, are ready to give you engineering service—can be especially helpful on your many grinding problems as you change from the production of regular products to defense products. A wealth of data on grinding in the defense industries has been compiled at Worcester—sent in by the field men everywhere for mutual use.

Trained Scientists

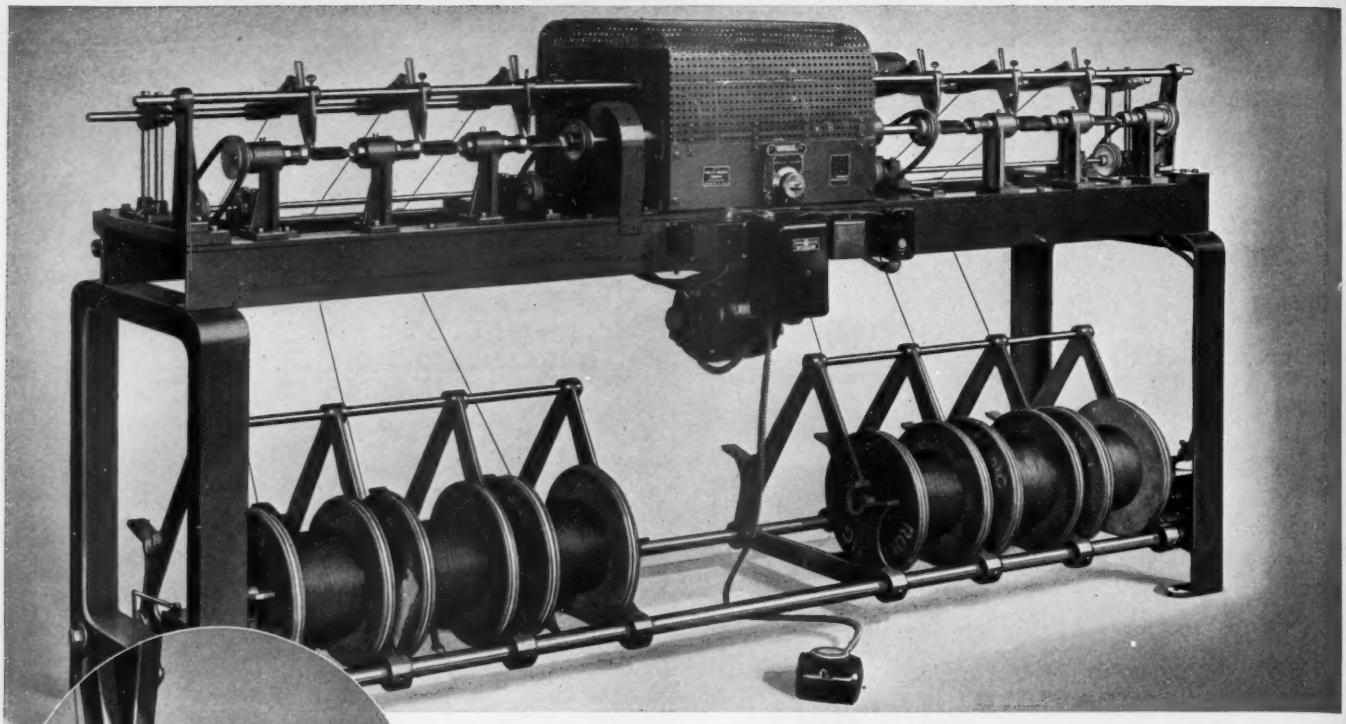
When some new defense product or material brings an entirely new grinding problem the Norton research laboratories are ready to help find the answer. A staff of over 50 trained scientists and technicians is constantly at work in well equipped laboratories that occupy over 45,000 square feet of floor space.

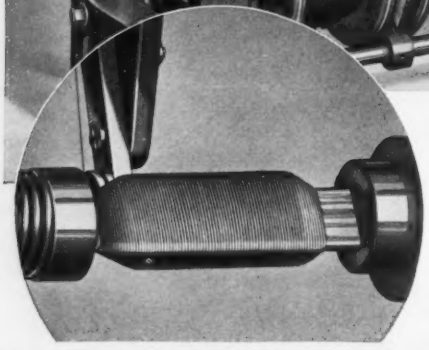
NORTON COMPANY, WORCESTER, MASS.





NORTON ABRASIVES



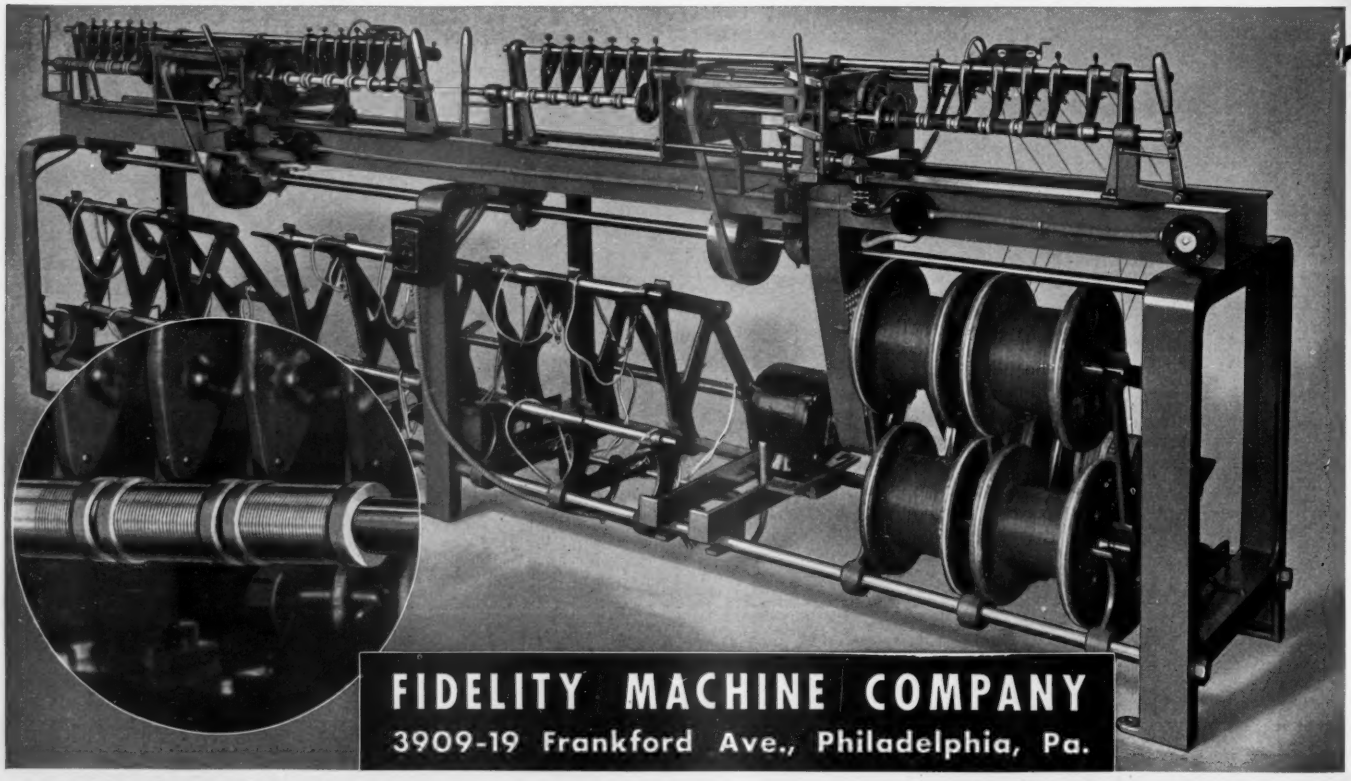


Above: FIDELITY Spooling Machine with new hydraulic control to wind wire on flat or square sticks from brake-controlled reels.
Below: FIDELITY Screw Traverse Machine winds wire on conventional type wooden or metallic spools.

FIDELITY Wire Spooling Machines
---from Reels or Coils
---to Sticks or Spools

Precision winding at high speed, with unvarying weight and even lay of wire on spool or stick—these are outstanding advantages of FIDELITY Wire Spooling Machines. They are quickly adjusted to required length, thickness or spacing—simple to operate, minimum labor attention and low horsepower.

Write for illustrated folder describing four types of standard machines and operating specifications.



FIDELITY MACHINE COMPANY
3909-19 Frankford Ave., Philadelphia, Pa.

Photograph by Courtesy of Western Electric Co., Inc.

THE STEVENS METAL PRODUCTS CO.

NILES, OHIO

MANUFACTURERS OF LOW-TARE STEEL REELS AND FLANGED STEEL DRUMS FOR REELS...

Manufactured under License Arrangements with Western Electric Co., Inc.

UPRIGHT ★ ★ ★

★ ★ ★ CONE

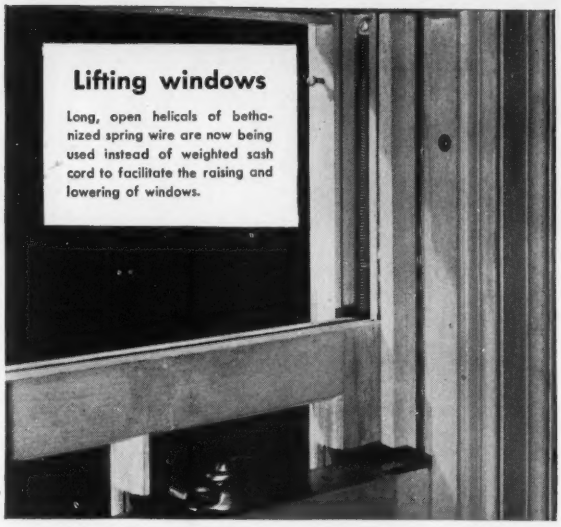
Wire Drawing & Machines

FOUNDED WATERBURY FARREL 1851

These high speed machines are available in several sizes and can be had with either a coiling block or spooler. The spooler may be an attachment or a separate floor-type device, such as shown. This is the No. 4 machine with belt-type cradle spooler. It is driven by a direct-coupled motor (not shown), has 13 dies and capacity for drawing copper from ¼" maximum starting size down to a finishing size of from No. 10 to No. 18 B. & S. gage. The dies and the hardened steel drawing rolls are enclosed by a rolling steel curtain to confine the splash of the drawing lubricant.

WATERBURY-FARREL
FOUNDRY & MACHINE COMPANY
Waterbury, Connecticut, U. S. A.
SALES OFFICES CHICAGO CLEVELAND NEWARK, N. J.

WHERE will it turn up next?



Lifting windows

Long, open helicals of bethanized spring wire are now being used instead of weighted sash cord to facilitate the raising and lowering of windows.

Lashing lead cables

Because of its heavier protective coating, bethanized wire is being used by a large telephone company to lash lead carrier cables to the messenger strand.

Taking the baby for a ride

Being both attractive in appearance and unusually corrosion-resistant, bethanized wire has been widely adopted for use as spokes in baby carriage wheels.

THE applications of bethanized wire are limited only by the imagination and eye to profit of its many users. Every day this electrolytically zinc-coated wire turns up in new applications, takes over new and tougher jobs, gives an amazing account of itself.

Bethanized wire can handle unusual jobs because it is zinc-coated by a special electrolytic process. The zinc coating is 99.9+ per cent pure, uniform both along and around the wire, and as ductile as gold leaf. Bethanized wire can be coiled, twisted, bent or drawn through dies without impairing the coating. Equally important, any desired weight of zinc within practical limits can be applied by the bethanizing process.

Why not investigate and test this special zinc-coated wire yourself? It is ideally suited for use in woven wire fabric, conveyor belting, pump chain, pail handles, automotive parts, twisted brush handles and scores of other products.

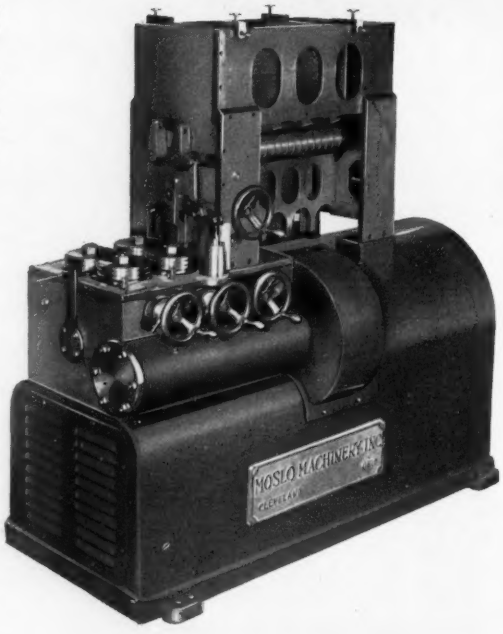
BETHANIZED WIRE

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Ease-IN WIRE HANDLING

Custom Built – For Production Work



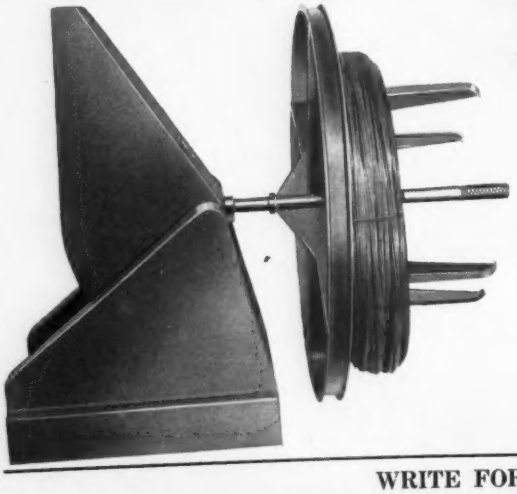
★ Here is a welding rod hopper custom designed to meet your production requirement. Simplicity of set-up and operating *ease* make the MOSLO AUTOMATIC WIRE FEEDER the foremost machine of its kind.

Compare these outstanding features:

Heavy Duty Construction — Large Capacity Hopper — Quick and Easy Adjustments — Variable Speed Motor Drive—Extremely Critical Specifications—Economical To Operate

MOSLO AUTOMATIC WIRE FEEDERS are scientifically engineered to incorporate these important features and many more. Leaders in the field who purchased units are reordering for their entire requirements. This is real proof of achievement.

Simplify your wire handling problems — investigate the MOSLO-WAY — today.



Only One Man Operates *"Shiftweight"*

★ Now more than ever the man saving *"Shiftweight"* Counterbalanced Tilting Wire Reel proves its effectiveness, because it actually reduces the work of two men to a simplified, easy job for one man.

"Shiftweight" is of sturdy construction and compact design. A unique braking system enables you to pull wire without snags or snarls.

"Shiftweight" comes in two sizes; the Senior handles a coil of wire or rod up to 300#, the Junior handles a coil of wire or rod up to 175#.

Your best bet for fast, easy wire handling is *"Shiftweight"*

Look for Announcement on Our Companion Machine
New Moslo Welding Rod Brushing Machine

WRITE FOR FREE BOOKLETS TO

"Shiftweight" REELS TAKE YOUR WIRE HANDLING COSTS OUT OF THE RED

"LET'S TALK ABOUT RESULTS"

MOSLO MACHINERY, INC.

4518 SUPERIOR AVENUE

CLEVELAND, OHIO

WIRE FOR A THOUSAND PRODUCTS

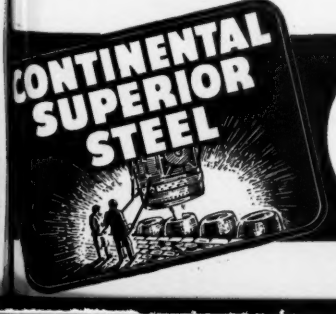
34 GAUGE to 5/8 INCH

● For nearly a generation the Continental wire plant has been producing high quality wire from open hearth steel. This wire has been steadily developed in quality and in range of specifications. Continental SUPERIOR WIRE is produced in a wide range of shapes and finishes and in sizes from fine 34 gauge to ⅝-inch. Multiply the number of sizes by the number of shapes, tempers and finishes in which this wire can be supplied and you get some idea of the infinite variety of specifications available in CONTINENTAL SUPERIOR WIRE.

CONTINENTAL STEEL CORPORATION, Kokomo, Indiana

Plants at Canton, Indianapolis and Kokomo

The Continental Superior label on manufacturers' wire is an assurance of quality and uniformity. It means that every step in the making of that wire from the charging of the open hearth furnaces to the final inspection of the wire has been under the supervision of metallurgists and trained men who are experts in this branch of steel making.



CONTINENTAL
STEEL CORPORATION

SHEETS: Black, Galvanized, Copperior, Hot and Cold Rolled, Special Coated, Long Terne, etc.

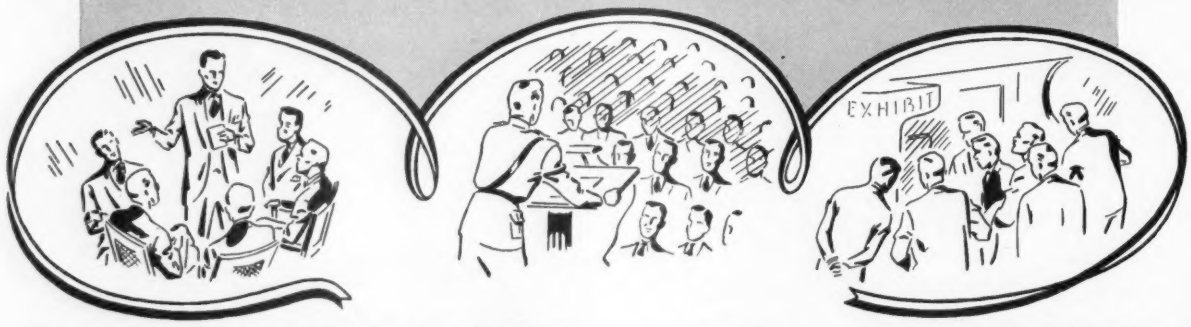
WIRE: Bright Basic, Annealed, KONIK, Copperod, Tinned, Special Manufacturer's, etc.

TAKE PART IN

THE METAL INDUSTRY'S

BIGGEST DEFENSE MANEUVERS!

PHILADELPHIA, OCTOBER 20-24



The entire metal industry is pooling its knowledge of defense production and conservation at the 1941 Metal Congress & Exposition in Philadelphia, October 20-24.

Under direct request of many manufacturers a comprehensive program of group meetings on Defense Problems, Conservation and Substitution has been prepared. These group meetings are not to be of the ordinary round-table type where everything is left to chance but are to be well-planned presentations.

A representative will present at each meeting the latest information on the scarce materials involved in the clinic and the status of substitute materials, also indicating how industry can assist in and adjust itself to the present shortages. Since meetings will be "off-the-record" men of industry will be free to discuss actual production problems and quote examples.

Subjects to be discussed include alloy steels, stainless, molybdenum, tool steels . . . alloy castings . . . bearing metals . . . shells . . . aluminum . . . magnesium . . . copper . . . inspection of metals . . . priorities, etc.

In addition to these afternoon and evening clinic meetings, more than 80 technical papers will be presented at regular annual meetings of the four technical societies who cooperate in the Metal Congress.

And—at the Metal Exposition—the exhibits of 300 leading manufacturers in the metal industry (largest show ever held) will feature the latest, most modern materials, equipment, and processes for speeding production.

Don't miss the opportunity of hearing the nation's leading defense experts in Philadelphia—your defense job demands representation at the Metal Congress & Exposition!

COOPERATING SOCIETIES

American Welding Society. Wire Association. American Society for Metals. Iron & Steel Division and Institute of Metals Division, American Institute of Mining & Metallurgical Engineers.

Address: W. H. Eisenman, Secretary, American Society for Metals, 7319 Euclid Ave., Cleveland, O.

OCT. 20-24

NATIONAL METAL CONGRESS AND EXPOSITION

PHILADELPHIA PUBLIC AUDITORIUMS

Managed by THE AMERICAN SOCIETY FOR METALS

"STANDARD" TURKS HEADS

THE FASTEST AND MOST ECONOMICAL METHOD OF:—

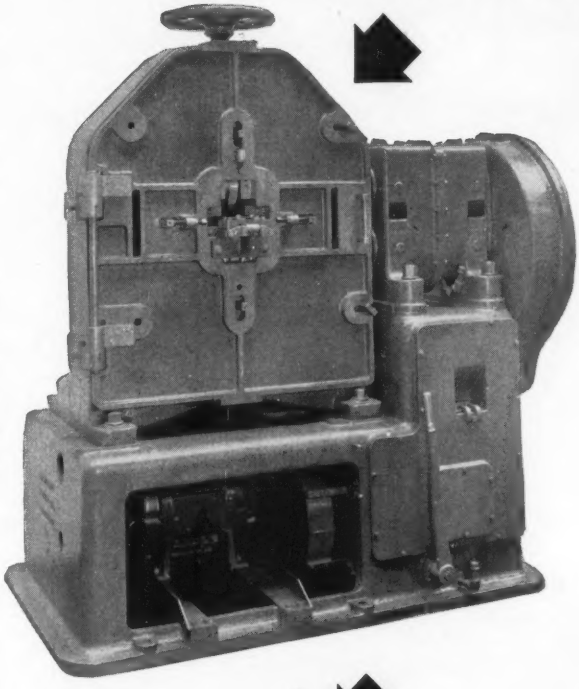
1 FORMING SPECIAL SHAPES FROM ROUND WIRE. . . . .

2 EMBOSSING DESIGNS AND TRADEMARKING. . . . . .

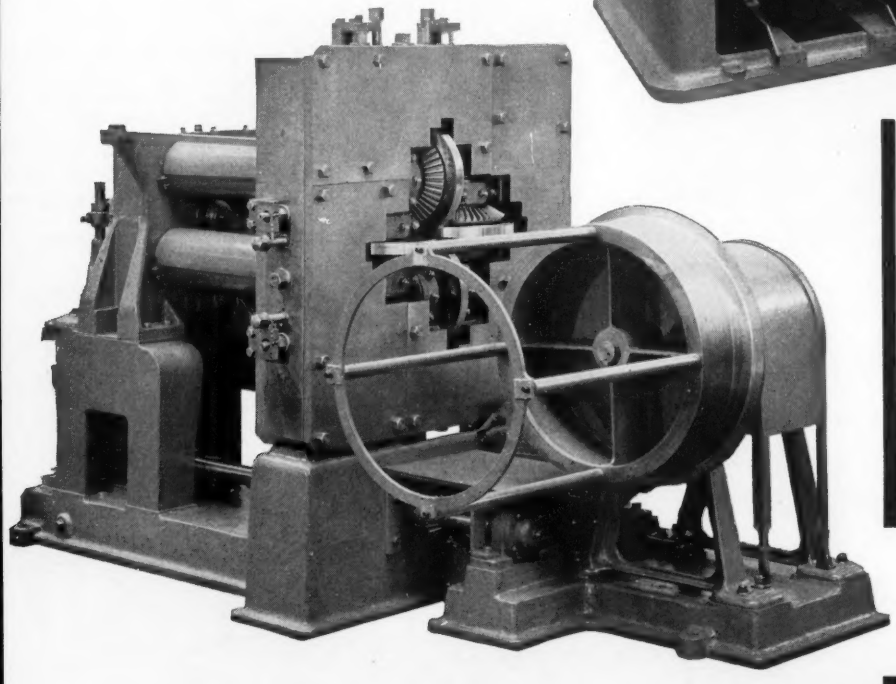
"Standard" Turks Heads, or adjustable draw plates, efficiently replace solid dies in reducing and forming wire from the round to rectangular and special shapes.

Available **with friction rolls** for light stock and short runs; **with power driven rolls** for higher rate of production, eliminating the need for a bull block or draw bench for moving the wire through the draw plates.

Rolled finished surfaces, characteristic of Turks Heads, are superior to solid die formed surfaces. Adjustment includes the forming of corners — sharp to well rounded.



The Power Driven Plain Type Turks Head used for forming special shapes — with formed rolls — and for embossing designs on special shapes.



The Power Driven Universal Type — with flat rolls only — is used for converting round wire into rectangular shapes, allowing for a wide variation in section size.

Write, stating your requirements (shape, stock, production, etc.) and we shall be glad to send specific recommendations, including price and delivery.

IT'S **STANDARD** PRACTICE

MACHINERY COMPANY

PROVIDENCE, RHODE ISLAND

WIRE for Practically All Purposes and Requirements

IRON—STEEL—ALLOY—LOW CARBON—HIGH CARBON

SHAPES

Square - Keystone - Flat
Round - Half Round - Special
Shapes - Straightened
and Cut

STOCK

High Carbon - Low Carbon
Alloy

Tempered and Untempered

FINISHES

Liquor Finish - Bright
Galvanized - Coppered
Enameled All Colors
Annealed - Tinned
Oil Tempered

FOR

Belt Hooks
Binding - Bonnets
Bookbinders
Brooms - Brushes
Clips - Cotter Pins
Crimping
Cushion Springs
Florist - Glass Wire
Grape Tying
Hair Pins - Heddles
Hook and Eyes
Link Fabrics
Lock Washers
Mattresses
Picture Cord - Pins
Rock Fasteners
Special Springs
Ropes - Stapling
Stone Wire
Tags - Weaving

WELDING WIRE RODS AND COILS—Sizes, ½" to No. 40 WM Gauge (.007)—All Finishes
• FLY SCREEN WIRE CLOTH • GALVANIZED HARDWARE CLOTH •

FLAT COLD ROLLED STRIP STEEL

Highest Quality and Service Guaranteed

Established 1905

The Seneca Wire & Mfg. Company

Fostoria, Ohio

Representatives and Warehouses in principal cities.

ECONOMIZE ON ZINC

with

MEAKER

PROCESS

for Electro-Galvanizing Wire

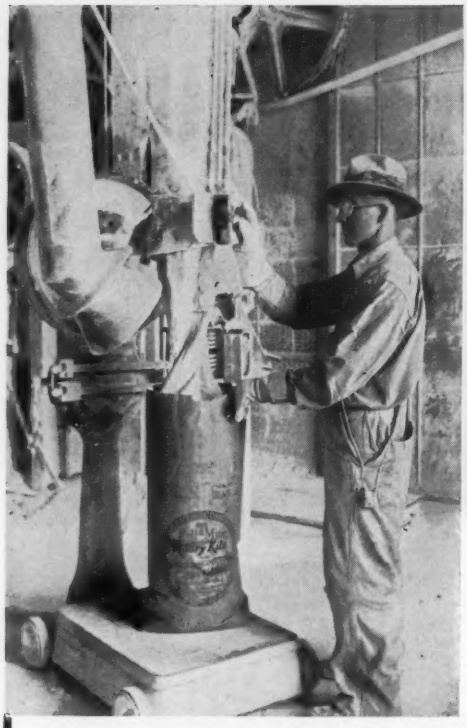
Even the lightest coatings are uniformly distributed on the wire surface. Control of coating thickness is exact. You can save on zinc, produce more perfect coatings, make more profit with Meaker Process for Electro-Galvanizing Wire.

"A proven success by every test"

WE INVITE YOUR INQUIRY

The* MEAKER *Company

1635 South 55th Avenue, Chicago



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Plant loadings in steel barrels have been eliminated under priority rulings.

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For Wire Drawing

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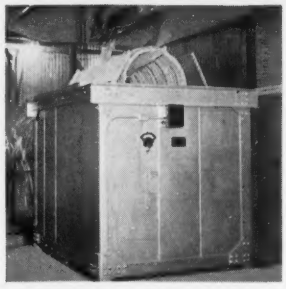

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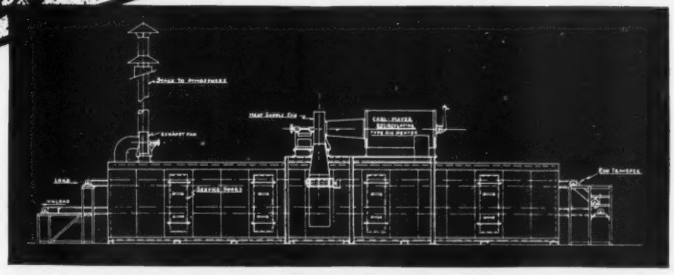
PATENT NOS.
U. S. A. 2235559
Canada 396144
Canada 465969
Other patent claims allowed and pending.



WELDING ROD OVENS

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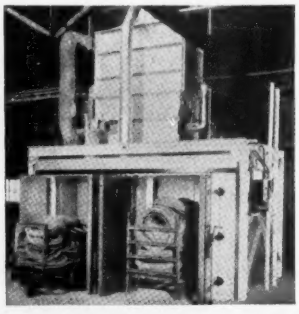

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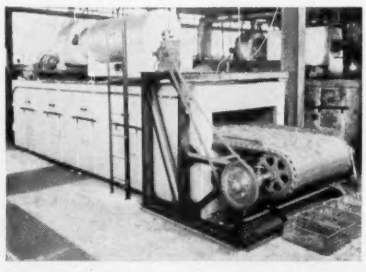

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"Time, Temperature and Size in the Heating of Steel Wire."

"Manufacture of Steel for Arc Welding Electrodes."

"High Speed Rotary Knitting Machine for Covering Electrical Conductors."

"Electrolytic Zinc Coated Wire"

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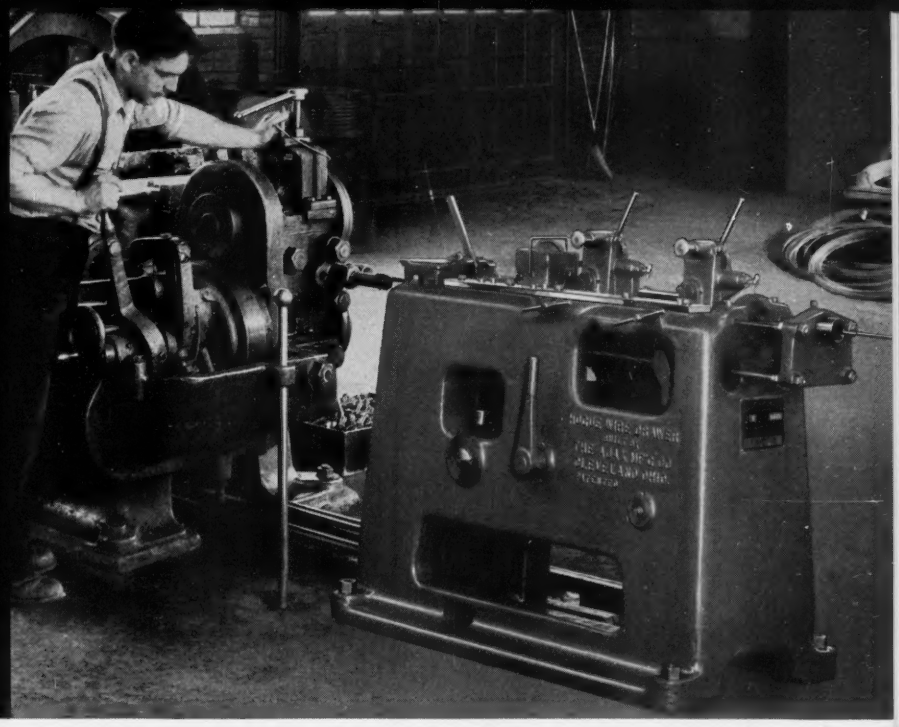

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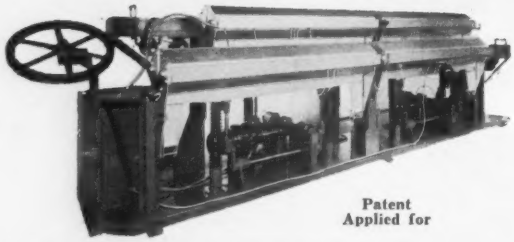
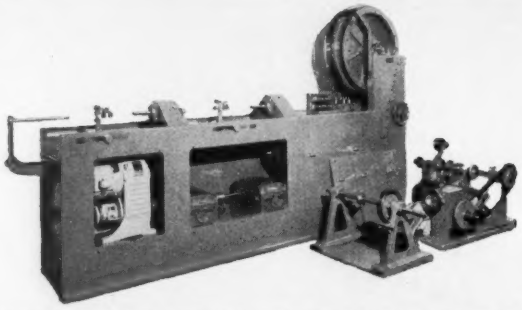


Patent
Applied for

ELECTRIC BAKING OVEN
for Varnished Glass Insulated Wire,
with Varnish Applicators and
Thermostatic Control.



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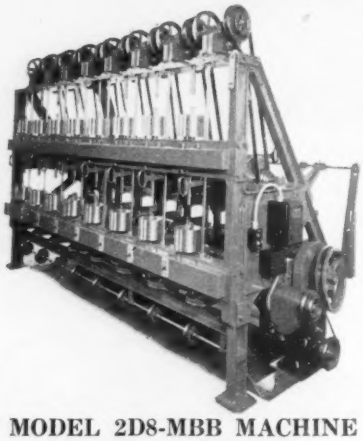
For All Types of Insulations



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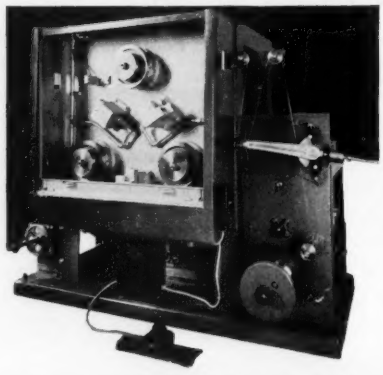
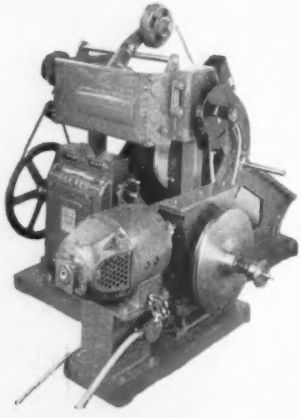


HIGH SPEED WIRE DRAWING MACHINE



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Ball Bearing Mounted,
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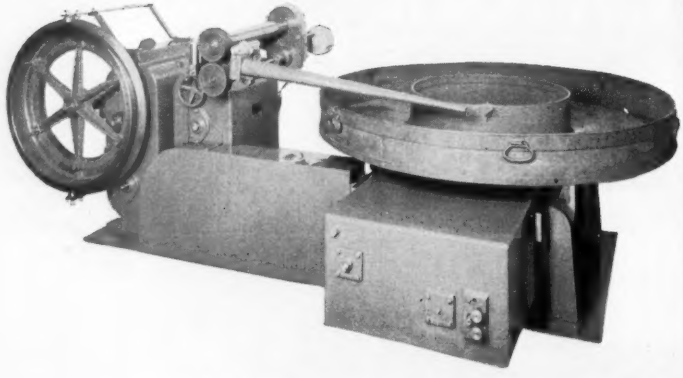

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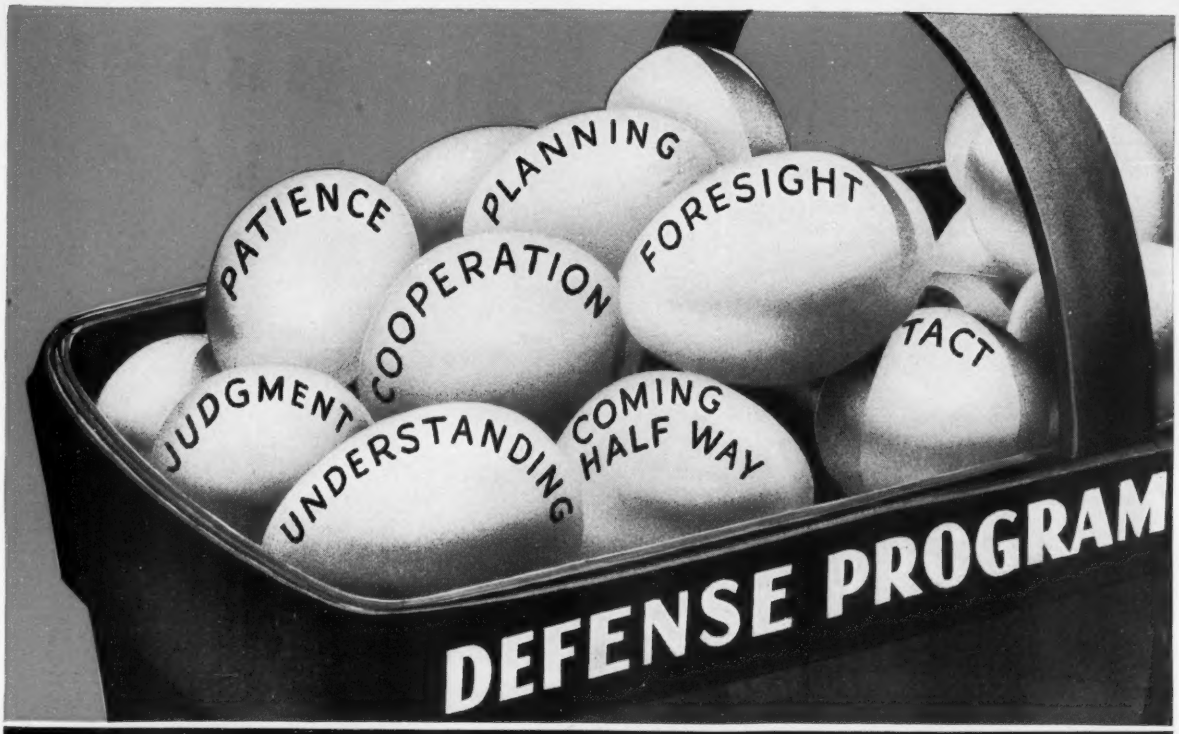

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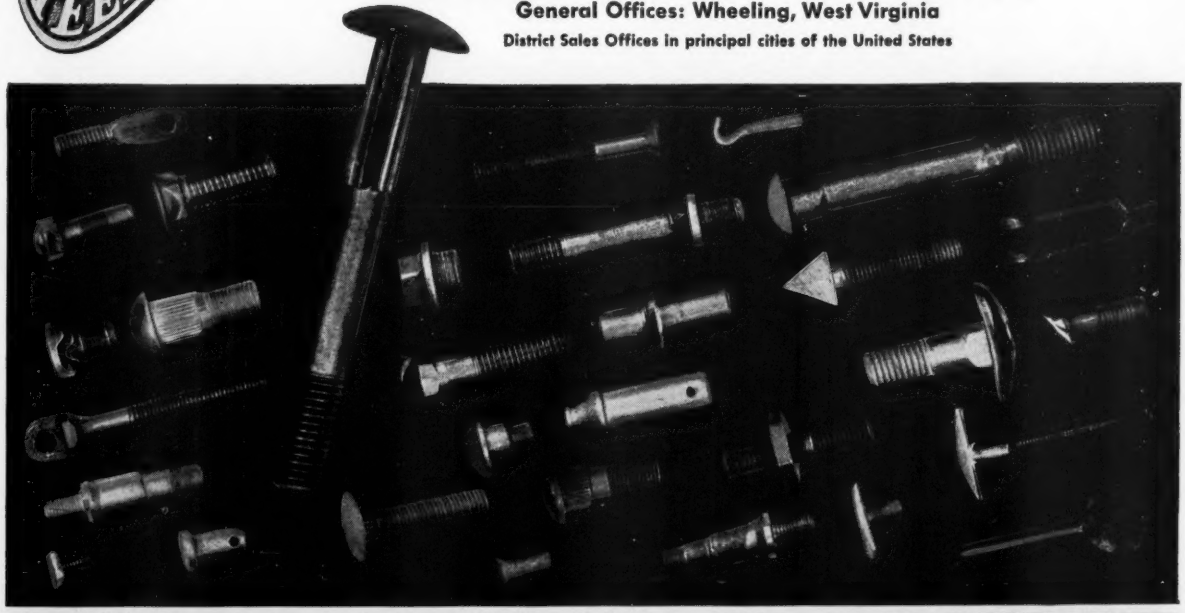

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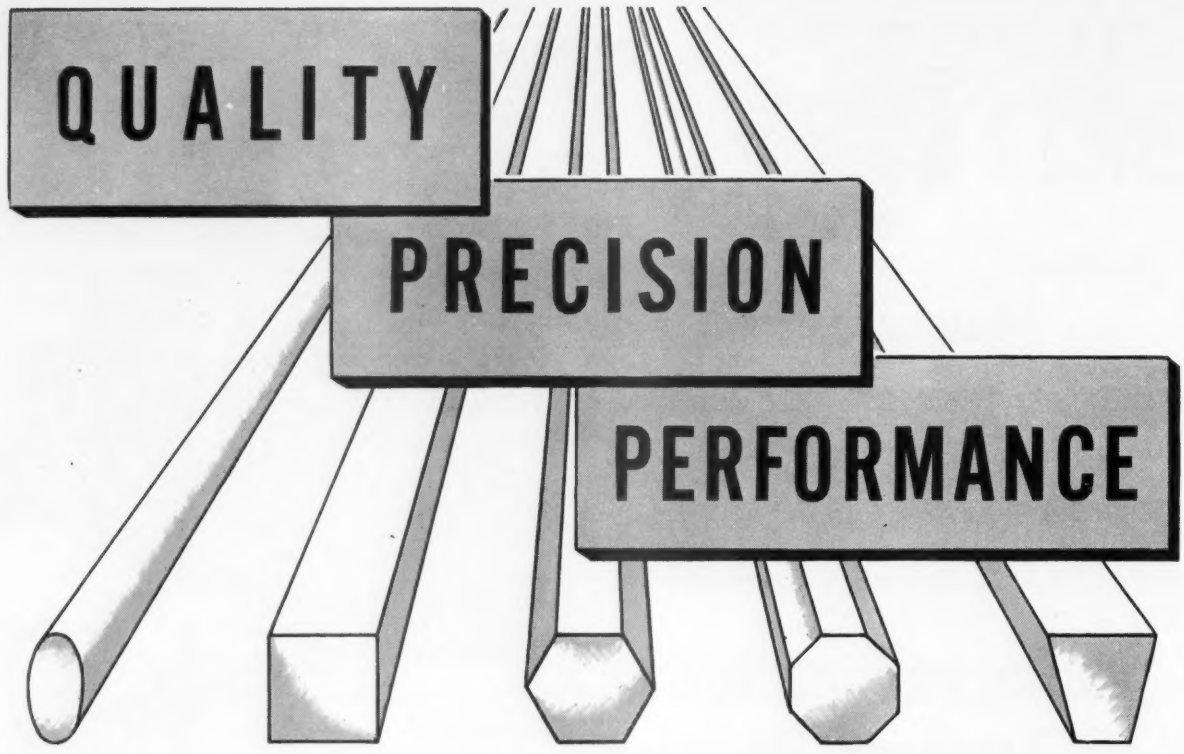

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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 16 OCTOBER, 1941 No. 10

Designated as

Official Publication By The Wire Association

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A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 16 OCTOBER, 1941 No. 10

A Brief Discussion on the Manufacture of Steel For Arc Welding Electrodes

By C. W. Garrett
Wire Mill Metallurgist,
Aliquippa Works, Jones and Laughlin Steel Corp., Aliquippa, Pa.

Certain features of major importance on manufacture of steel for arc welding electrodes are discussed here. These include chemical analysis, steel making practices, heating and rolling technique, preparation of the rod for drawing, wire drawing practices and testing procedure. ✦ ✦

"THERE is nothing new under the sun," so spoke an ancient philosopher, and daily we are reminded of the deep truth of this statement. However, man is an inquisitive animal and by virtue of his curiosity, progress and civilization were made possible. In a broad discussion on an article or process of universal use, the introduction invariably brings out the fact that civilization, as we know it, would not be possible if that particular item under discussion were lacking from the picture. Our topic can offer no such extravagant claims, for electric-arc welding is a mere infant in the family of technical progress. However it has already reached the indispensable stage.

✦ ✦ ✦

IT is the purpose of this paper to discuss, briefly, those factors that are considered of major importance in the production of quality wire for application to arc-welding electrodes. These features include chemical analysis, steel making practices, heating and rolling technique, preparation of the rod for drawing, wire drawing practice and testing procedure. The proper control of these factors in the light of our present knowledge of what constitutes a good welding wire, usually makes it possible for the electrode manufacturer to regularly obtain a reliable steel base material.

C. W. GARRETT

Graduated Michigan College of Mining and Technology, B.S. Ferrous Metallurgy, 1932; Master's Degree, 1933; Istructor, 1934-35. Then successively Ford Motor Co. Metallurgical Laboratory, Cuyahoga Works of American Steel & Wire Co., and Janes & Laughlin Steel Corp., as welding Wire Investigator. In 1938 became Wire Mill Metallurgist of Aliquippa Works. Member of American Society for Metals, American Institute of Mining and Metallurgical Engineers and The Wire Association.

✦ ✦ ✦

THE arc-welding industry during the last decade has indeed made phenomenal progress with indications that its future progress will perhaps be even greater. There is still much work to be accomplished in the field of welding wire for core and filler metal, but, no longer can the proprietor of the village general store feel perfectly competent to cut coiled mild steel wire into suitable lengths, bundle the pieces and sell the product as arc-welding electrodes.

✦ ✦ ✦

AMONG the growing pains of our infant industry must be

Designated as Official Publication by the Wire Association

MANUFACTURERS OF INDUSTRIAL FURNACES • JANITROL GAS-FIRED SPACE HEATING EQUIPMENT • AND KATHABAR AIR CONDITIONING SYSTEM

included the problem which faced the Welding Engineer, of explaining to the steel manufacturer just what was required in the way of steel quality. While it was quite simple for the manufacturer of arc-welding rods to set up various chemical ranges, there was soon a recognition of the fact that desirable steel quality for welding required far more than a fulfillment of specified chemical ranges. Heats of steel with identical analysis, in so far as the usual elements are concerned, too often showed wide differences in the performance under the electric arc. Extensive investigations have been conducted to properly identify the factors chiefly responsible for poor arc performance and to set up steel making practices most suitable for the grade of rod involved.

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OCCLUDED gases and gas forming oxides were early suspected of being one of the chief causes for poor arcing characteristics and spatter. Carefully worked out deoxidizing schedules and slag control have gone far to produce a steel relatively free from those impurities affecting arc performance.

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INGOT practices and subsequent effect of various ingot structures on the performance of the finished wire have been carefully studied and classified. The adverse effect on welding performance of such segregating elements as sulphur and phosphorus have been recognized for some time. In producing steel for welding wire therefore special care is taken to keep these elements to a minimum.

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BY far the greater portion of arc welding wire is today produced by the Basic Open Hearth process. The various carbon ranges progress from the low carbon SAE 1010 grade to the hard facing material of SAE 1095 composition. However, approximately 80% of the steel made for electric arc welding wire falls in the low carbon range (.07 - .16 C).

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NEXT in importance to steel quality is the wire finish demanded for the various grades of welding wire, and here again special practices have been developed to satisfy the manufacturer of electrodes. Closely associated with wire mill practice is control of microstructure which in itself has an important bearing on the performance of the rod under the arc.

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HOWEVER, the most perfect control of all these variables does not necessarily guarantee a wire which will meet with the approval of the purchaser if the specifications accompanying the order are not complete in every detail. In fact a considerable portion of the welding industry's difficulty in obtaining satisfactory wire has been due to their failure to make clear just what they required in the way of a satisfactory product.

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IT is our purpose to limit this discussion to the low carbon filler wire of approximately .08/.15 C and the proper starting point is in the steel making practice. Practically all of the low carbon electrode steel used today is made from rimmed ingots. Capped steels and killed steels have been investigated, but to date, rimmed steel has been found to give the most consistently satisfactory results.

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IN rimming steel ingots, gas is evolved by the carbon-iron oxide reaction, and the thickness of the rim is controlled by the rate that the gas is evolved and on the rate at which the metal solidifies. In reviewing a large number of heats it has been found that satisfactory welding wire usually results when the oxidation of the steel has been controlled to result in a slight drop of ingot top after pouring. When the steel rises in the ingot mould, unsatisfactory welding wire is more frequently encountered. In our practice, best rimming results are obtained with available iron oxide in the slag of about 20 to 25%.

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PREPARATORY to pouring, the stools and inner surfaces of the moulds should be carefully cleaned of all foreign material from previous heats, and should be properly prepared with tar, graphite, or other mould coating to insure a clean surface ingot.

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STEEL for arc-welding electrodes may generally be considered to show most desirable performance when phosphorus and sulphur content is held to fairly low limits, i.e., .020% max. phosphorus and .035% max. sulphur. Numerous investigations have definitely proven that high sulphur heats invariably produce wild and erratic electrodes with high spatter loss and poor penetration. Practically all the sulphur is present as manganese sulphide inclusions, which, elongated by the wire drawing operation, is one of the most prolific sources of gas explosions in electric arc welding.

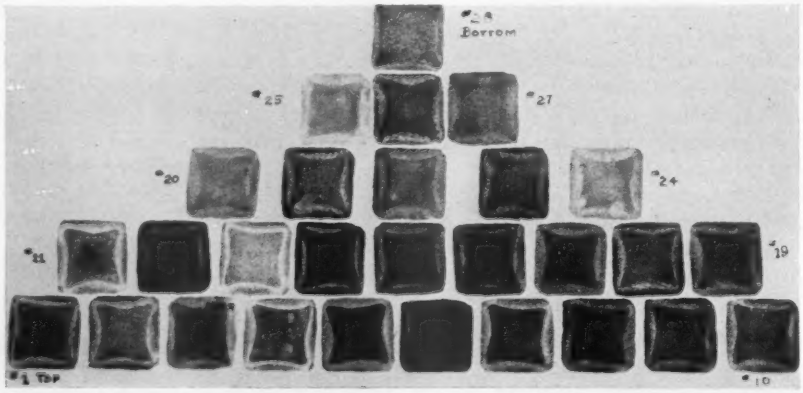

Figure 1

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PROPER ingot croppage is another "must." Failure to eliminate all the pipe cavity and excessive segregation will probably result in extreme arc blow and erratic sparking under the electric arc. In one case, when welding with a heavily coated electrode, we found it very difficult to hold a satisfactory arc. One explosion practically emptied the pool of molten metal in the weld bead. Microscopic examination of the fused tip of the electrode revealed a crater covering approximately 40% of the cross-section and at the base of the crater were fused remnants of manganese-sulphide and slag inclusions. Chemical analysis revealed a .073 S content against a .028 S ladle. This is an extreme case of sulphur segregation but it indicates that trouble might be encountered with this type of segregation when present in lesser degree.

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MR. R. NOTVEST has contributed the following: "Steel drawn out into welding wire for arc welding electrodes must not only have a minimum content of dissolved gas, but more important, must be reasonably free of non-metallic inclusions (oxides and microscopic slag particles) which through chemical reactions at elevated temperatures form gas which is suddenly released at the moment of congealing, causing porosity in the fusion metal. The criterion is the solubility of such oxides and slag inclusions in the metal, if they are of only microscopic proportions, insoluble and fairly uniformly distributed throughout the structure of the metal, the detrimental effect won't be very serious either as far as reduction of physical characteristics or gas evolution is concerned. The deoxidation process by means of ferro-manganese or ferro-silicon is nothing but a rather successful attempt to change soluble monoxides to insoluble ones, which, being very much lighter than the metal involved, have a better chance of being eliminated by rising to the surface and becoming a part of the slag."

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OF the several types of electrodes in use; bare, washed, dipped, or heavily coated, steel for the last named type is the steel manufacturer's biggest headache. He has to make a steel with nicely balanced constituents that will work in harmony with a customer's particular type of coating. Due to the variety of flux coatings used, it is impossible to determine just how the filler wire will act with a given coating except by trial and experience. However, we have discovered that when a wire cleaned of all drawing lubricant is melted as an electrode and holds a quiet arc with small spatter loss, such a wire will give satisfactory results as a heavily coated rod. Another method of evaluating a heat is the "melting rate" test wherein a $\frac{3}{16}$" bare wire is melted under standard conditions for one minute.

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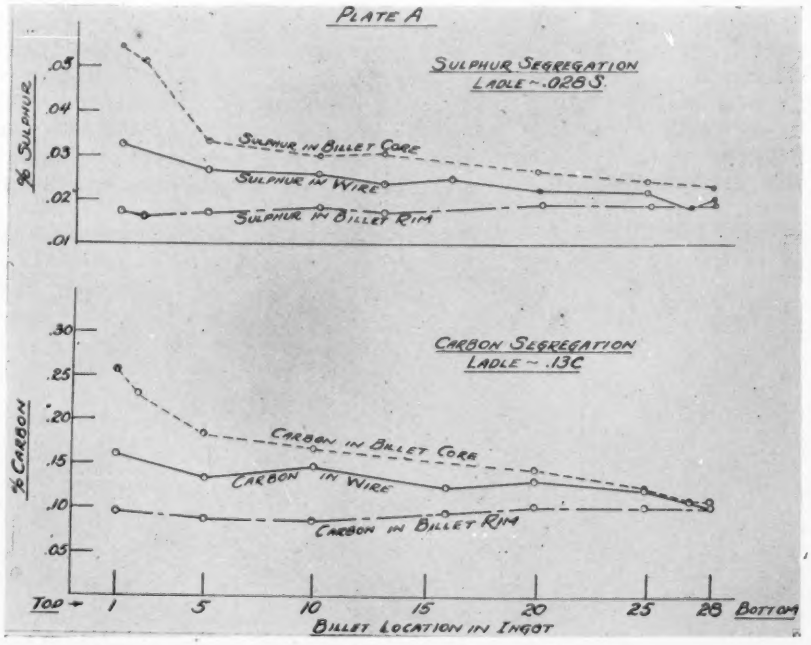
RIMMED steel with its progressive degree of segregation from bottom to top of the ingot presents the problem of holding the carbon range within the desired limits. We are including a chart (Plate A) illustrating the degree of segregation of carbon and sulphur in a .13 C - .028 S ladle head made to a .10/.15 C and .035 max. sulphur specification. At the top of the ingot there is a pronounced difference between the analysis of the rim and the core in carbon and sulphur, but this becomes nearly equalized in the lower portion of the ingot. **Fig. I** illustrates the etch test in billets from top to bottom of an ingot from this heat. Bottom billet (#28) shows slight rimming with a mottled core of least segregated material. Phosphorus and manganese are comparatively uniform throughout. Ferro-titanium was used as a deoxidizer in this heat but no titanium could be detected in any part of the ingot. This is explainable by the fact that the total titanium added amounted to only .01%, most of which was oxidized and entered the slag as TiO_2. The effect of titanium as a deoxidizer appears to be a reduction of iron soluble oxides without exerting any "killing" effect.

PLATE A



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IT must be borne in mind that when a rimmed ingot is processed down to wire form, the core section will still retain the ingot mold pattern. Improper rolling sequence in the billet or rod mill will distort this pattern and may

force it to the surface of the wire. The detrimental effect of such a condition is more easily explained by reference to **Fig. II.** Herein is illustrated the rimmed pattern on the cross section of a rod. The approximately square section is an ideal core pattern and superimposed is a core pattern that has been badly distorted by improper rolling sequence. In electric welding Point "A" worked to the surface of the wire, will serve as a center of electrical impulse and an excessive magnetic side blow will result. Such a wire will deposit an irregular bead with high spatter loss. Due to the great number of passes necessary to reduce an ingot to a rod there is usually considerable distortion of the rim. However, the cases where the rim breaks through to the surface are relatively infrequent.

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ANOTHER source of a gaseous rod has its origin in the rod mill where the square billet is reduced very rapidly to a small size rod. In the early passes of the finishing stands, a too closely set pair of rolls will produce what is known as a "finned" section. The ensuing passes will fold this fin over to form a "lap," entrapping the quickly forming scale, or magnetic oxide. This entrapped scale will later reveal itself as gaseous explosions under the electric arc. Such a condition is illustrated in **Fig. III.**

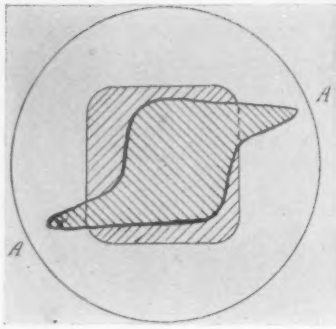

Figure II

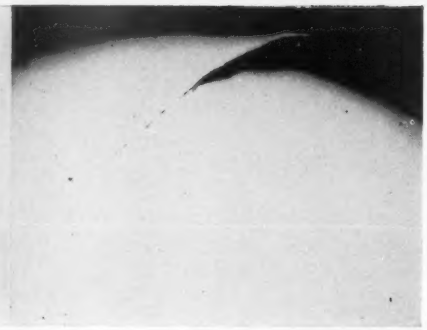

Figure III

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A POOR section rod will prove troublesome in the cleaning and liming operation. One example of this is the "over-filled" rod. Such a rod will clean properly but in the liming operation there is very apt to be a concentration of lime at the junction of the overfill

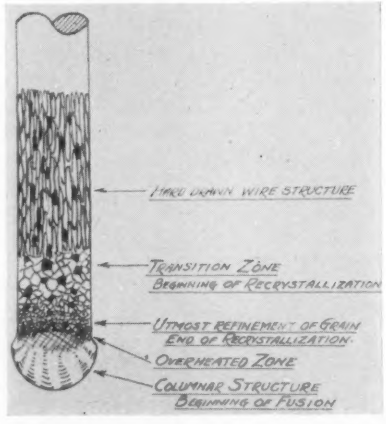

Plate B

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and the rod contour. In drawing to wire this lime concentration results in a streaky surface.

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CAREFUL precautions must be taken in preparing the hot rolled rod for wire drawing. Careless work in the cleaning house is reflected in the appearance of the finished wire. A poorly cleaned rod results in excessive die wear and scratched wire. An over pickled rod invariably shows the finished wire carrying an excessive amount of drawing lubricant that would react adversely with the flux coating of an arc-welding electrode.

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PRACTICALLY universal use of Tungsten Carbide dies insures a uniform, round wire section well within commercial tolerance. However, a poorly aligned die will result in mal-distribution of cold work and the resultant lime streaks will not aid in the manufacture of a uniform welding rod.

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THERE is a wide difference in welding electrodes when compared on the basis of annealed and cold worked structure, but only a small amount of cold work is necessary to bring about stabilizing effect and slower melting rates. Approximately 30% reduction by cold drawing will accomp-

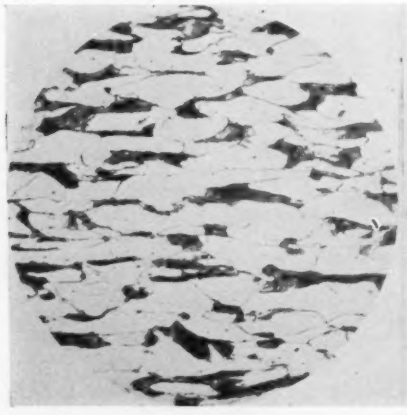

Figure IV

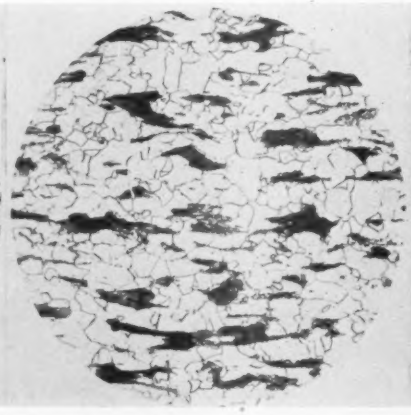

Figure V

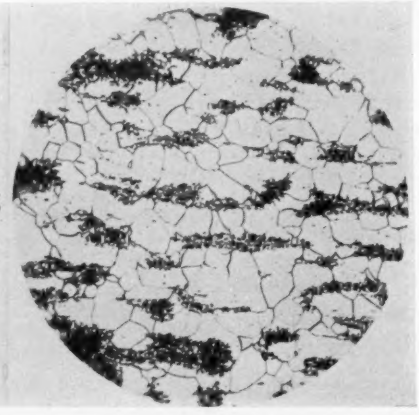

Figure VI

lish this with no apparent change taking place with further cold work. Wire, freed from cold work by normalizing, increases the melting rate from 30 to 100%. To determine the reason for this, an investigation was made on the very end of the welding rod where drop formation had taken place. Various specimens taken at this location revealed the following interesting phenomena: Plate 'B' illustrates the change in microstructure at the fused end of a hard drawn wire. There is always a transition zone of different length where the original grain has been broken down and recrystallized with the pearlite going into the grain boundaries, resulting in an extremely fine grain structure. From here it passes into the over-heated zone and fusion. Photomicrographs of these different stages are as follows: Fig. IV is the longitudinal section of hard drawn wire of .10/.15 C steel. The grain is relatively fine with a pronounced elongation. Fig. V is the beginning of the transition zone, where the strongly elongated Ferrite crystals begin to recrystallize, the Pearlite areas have undergone little or no change. In Fig. VI the recrystallized ferrite is coalescing into larger grains and the pearlite is in the first stage of spheroidization. Fig. VII illustrates the end of recrystallization and the migrating carbides are breaking down the large ferritic grains. Fig. VIII shows the over heated zone of super-saturated carbon in ferrite with the characteristic Widmannsträtten

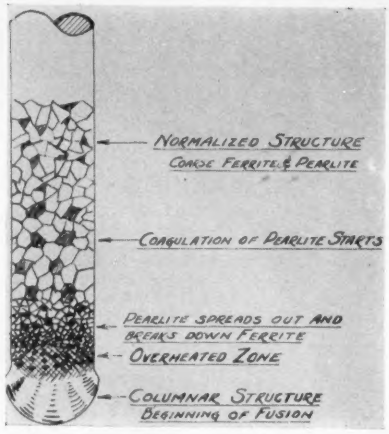

Plate C.

structure. Fig. IX depicts the fused structure at the tip of the electrode.

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PLATE 'C' is a sketch of the fused end of a normalized wire of the same composition as the hard drawn wire. Here again we encountered a transition zone, but quite different from that of the direct drawn wire. Fig. X is the same wire as illustrated in Fig. IV, however, normalizing at 1800°F has brought about recrystallization and coarsening of the grain size. The pearlite has coagulated into large irregular areas. Fig. XI depicts the transition zone where the pearlite starts to break down the ferrite, in the same manner as shown in Fig. VII. The transition from this structure to the overheated zone and thence to the fused columnar structure, is identical as those in the hard drawn wire.

JUDGING from the melting rates which are much slower in the hard drawn wire as compared with the normalized wire, it appears that the latter with its coarse grain requires considerably less energy to melt than fine grain direct drawn wire. Consequently, a given current of electrical energy should melt a larger volume of normalized wire than hard drawn wire. There is similar evidence in **Tammann's** corresponding experiments on Aluminum and Copper Alloys **(G. Tammann-"Lehrbuch der Metallkunde").** According to this authority, cold work will increase the energy content of any metal. Hence it follows that the heat for normalizing will compensate for the additional energy introduced by the cold work effect.

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COMMERCIAL advantage is taken of this faster melting rate of normalized (or annealed) wire in utilizing such rods in the welding of thin sheets and repair work on cast iron. Low electrical current and consequently less heat involved is advantageous in both these cases.

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IN spite of the great amount of work done in the field of steelmaking for electric-arc welding rods, there is still a wide difference of opinion as to the exact cause of the different behavior of electrodes processed from different heats of steel made under identical practices. Considering the available data, we have about convinced ourselves that it is the

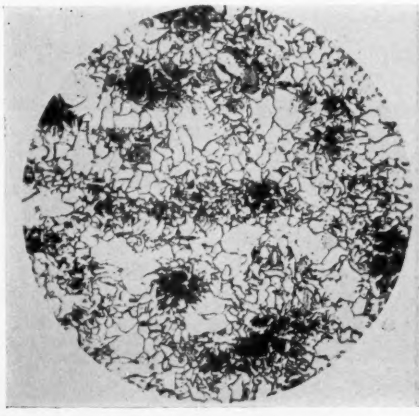

Figure VII

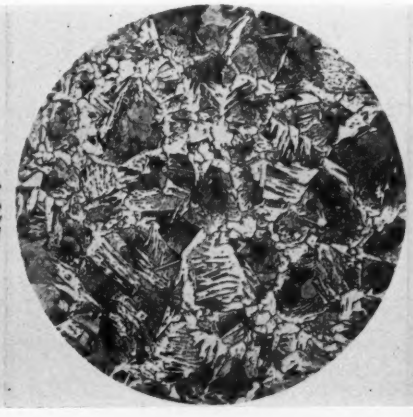

Figure VIII

Figure IX

occluded gas content plus the potential gas content (from gas forming constituents) which controls largely the behavior of the electrodes.

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SINCE a direct proof is lacking, the following is only in the form of an explanation which must fit into all known phenomena if it can claim any validity. The assumption, that segregation of carbon and sulphur exerts the decisive influence, does not appear convincing when it is realized that capped steel generally shows less segregation than rimmed steel, and that killed steel has little or no marked segregation. Again it seems not the absolute magnitude of these segregated elements, but the relative magnitude in relation to the average analysis which is connected with the different behavior. For instance, a heat high in carbon and sulphur shows a greater amount of these two elements in every portion of an ingot than a heat low in carbon and sulphur, and yet, both heats may yield similar melting characteristics. Furthermore, annealing with its partial resultant diffusion of segregated elements, should decrease somewhat the melting rate instead of increasing it, although it is recognized that this can be offset by the relieved grain which needs less energy for melting, but applied on processed wire, the subsequent cold work should lower the melting rate on account of the preceding anneal.

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ALL facts are more easily correlated under the assumption that the gas content and gas producing metalloids of the steel seem to play the decisive role. Without going into details, it could explain why there is a distinct difference between rimmed, capped and killed steel, and why the rimmed ingot possesses different charcteristics.

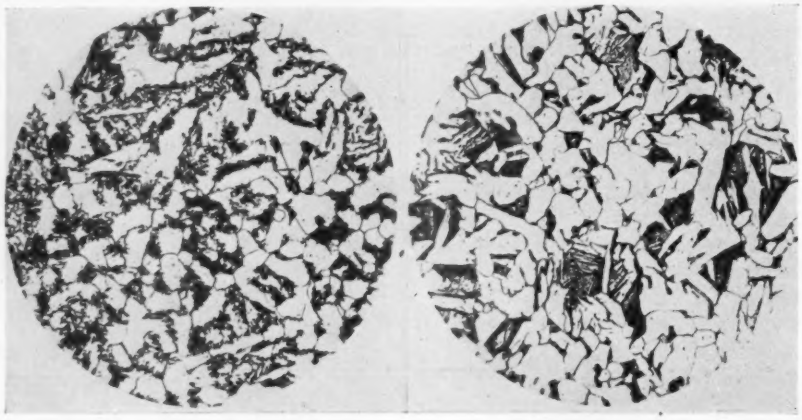

Figure X ✦ ✦ ✦ ✦ Figure XI ✦ ✦ ✦ ✦

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FROM the foregoing we may conclude welding wire, or more accurately, filler rod with which we have to deal is judged by:

(1) **External appearance, i.e., finish.**

(2) **Melting rate per minute of a given size, i.e., slow or fast.**

(3) **Arcing characteristics, i.e., smooth, erratic, or wild.**

(4) **Penetration, i.e., union of weld with parent metal.**

(5) **Subjecting welds made from it to physical, chemical and other tests.**

THE execution of all tests is time consuming and costly. We have utilized, for inspection purposes, the determination of melting rates which allows study of arcing charcteristics and penetration at the same time. Such testing is quick and simple, but is not necessarily a criterion of the ultimate physical properties of the weld deposited by a heavily coated electrode.

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TO sum up the steel producers' problems in the manufacture of steel for filler metal, close cooperation with the electrode manufacturer is of paramount importance. Next, correct line up of steel making, proper croppage of ingots and billets, efficient rolling sequence to insure freedom from laps, seams and overfills in the hot-rolled rods and close control of cleaning and drafting practices. All would contribute to the production of finished electrodes low in reactive impurities that cause such havoc when melted under the electric arc.

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ACKNOWLEDGMENT

We wish to thank Mr. J. W. Thurman, Metallographist, Aliquippa Works, Jones & Laughlin Steel Corporation, for his excellent photographic work and Mr. A. M. Reeder for his invaluable advice and constructive criticism.

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General Bulletin *(See Note Below)* *June, 1941*

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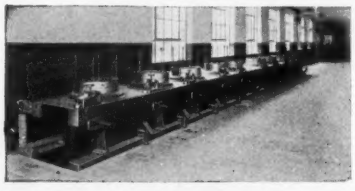

First Floor View

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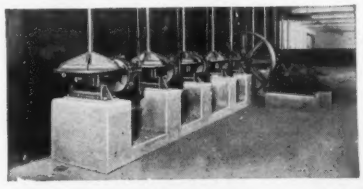
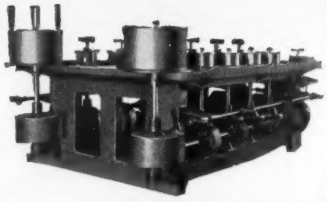
Embodies the latest and most improved practice. Long, stiff, vertical Block Spindles, each equipped with powerful friction clutches, and running in anti-friction bearings provide smooth running and practically noiseless operation. This improved 10-Block Rod Frame will reduce costs over any Single Block Frame now offered.



Basement View

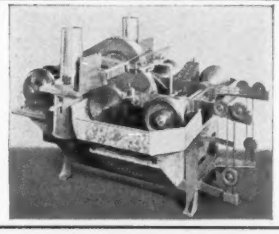


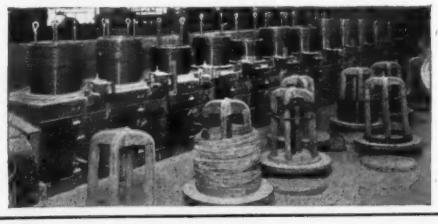
DOUBLE 5 or 6 DRAFT DRY INTERMEDIATE

These machines employ C. I. frames, table, girts, etc. Bronze replaceable drums. 16″ Blocks, cut gears. Drives are made to suit customers requirements.

DOUBLE 6-8 or 10 DRAFT CONE TYPE WET

These machines have proven very satisfactory for basic and High Carbon Wires. C. I. frames, table, girts, etc. Steel replaceable plate drums, 8″ blocks, cut gears. Direct motor drive or pulley drive to suit.

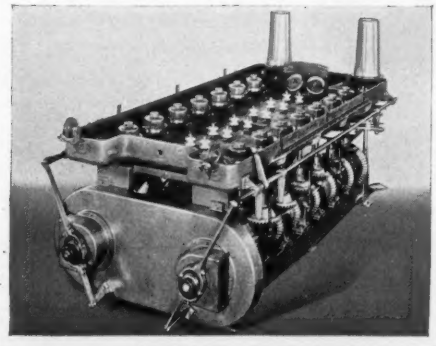




EXTRA HEAVY 15 FRAME for Basic or High Carbon Wire with cut gears and steel frame drive to suit, and double-deck blocks where required.

DOUBLE 8 DRAFT FINE WIRE PAN TYPE WET

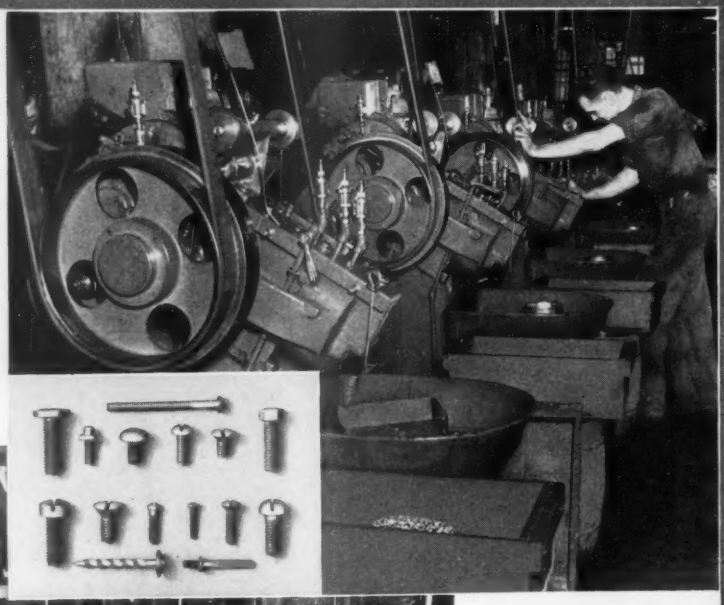
These machines have met with the approval of fine wire operators throughout the country. Replaceable steel or bronze drums, 8″ blocks, pulley or motor drive to suit.



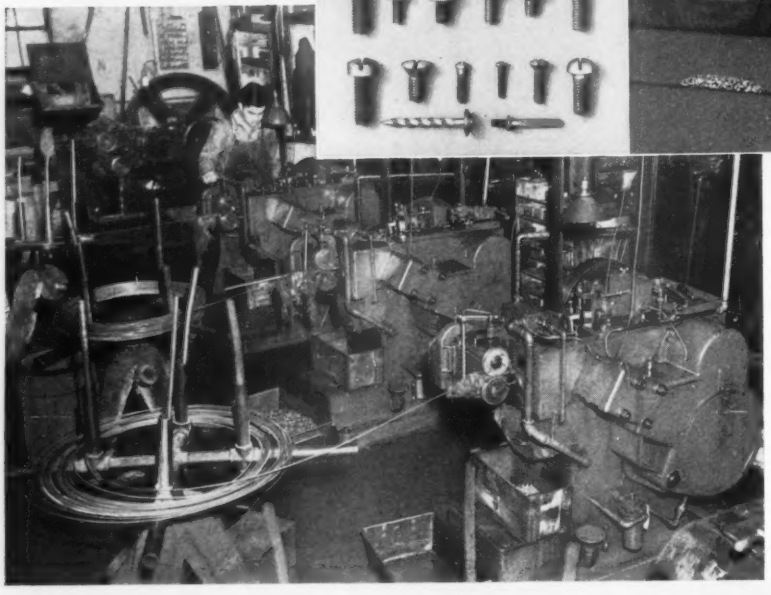
Note:—*This is page 4 of our new 4-Page General Bulletin. Your copy is ready.*

Machine Screws

By the million



Right. Each machine in this battery of Waterbury-Farrel Automatic Screw Thread Rollers will do more than 1,000,000 No. 10 machine screws a month. These machines are available in sizes up to and including ¾".



Left. The latest in High Speed Cold Headers—a group of Waterbury-Farrel "Hi-Pro" Double Blow Headers. Production: $\frac{1}{16}$"—225 per min; $\frac{5}{16}$"—175 per min.

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Effects of Microstructure on the Galvanizing Characteristics of Steel

By Robert W. Sandelin
Metallurgist,
Atlantic Steel Co., Atlanta, Ga.

The technique of successful hot dip galvanizing resolves itself upon a close control over the factors which affect the physical and chemical characteristics of the coating. Appearance, ductility, adherence and coating weight are among the more important considerations in the evaluation of coating quality. The achievement of such control through a better understanding of the effects of certain fundamental factors should be highly desirable and would result in improved practice. ✦ ✦

THE properties of a hot-dip galvanized coating are dependent, among other things, upon the character of the steel base. It is a well known fact that the chemical composition of the base metal has a very marked influence upon its galvanizing characteristics. However, in addition to the specific effects of the chemical composition of the steel, the physical character of the steel as regards its microstructure also exerts certain specific effects upon appearance and coating weight.

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COATING weight and appearance are properties of prime importance in determining the relative quality of a hot-dip galvanized product. Both of these properties are affected to some extent by factors of a microcharacter such as: (1) grain size, (2) cold work, and (3) various forms of heat treatment.

✦ ✦ ✦

THE published literature in the particular field of hot dip galvanizing with the effects of cold work, grain size and miscellaneous forms of heat treatment are very meager, possibly for the reason that materials subjected to the various treatments mentioned are seldom galvanized.

✦ ✦ ✦

BABLIK (1)[1], states that slag inclusions may result in poor appearance of a galvanized product. It is also claimed that the structural form in which carbon occurs affects galvanizing, however the specific effects were not mentioned. **M. von Schwarz** and **H. Fromm (2)** in their recent work concluded that the more completely the carbon was precipitated in low carburized sheets during annealing as grain boundary cementite the more uniform was the galvanizing, and the galvanizing was inferior where pearlite occurred along with grain boundary cementite. This was attributed to the action of hydrogen which penetrates during pickling into any discontinuities in the grain structure and is driven out again by the heat of the galvanizing bath and thus disturbs the crystallization of the zinc.

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IN regard to the effects of cold work, grain size and heat treatment, no data were available in the published literature. It is believed that a knowledge of the specific effects of these various treatment factors might be interesting and possibly prove to be of some value when considered in conjunction with the known effect of chemical composition of the steel base.

✦ ✦ ✦

THE present study in hot dip galvanizing consists of investigating the effects upon appearance and coating weight of: (1) varying amounts of cold deformation, (2) varying grain size in the same steel, ranging from fine to coarse grain, (3) water quenching from hardening temperatures, (4) carburizing, and (5) carburizing and quenching.

✦ ✦ ✦

Materials

IN all, 40 steels were prepared for this investigation being derived from three individual heats the analyses of which are shown in

Table I

Chemical Composition of the Heats of Steel Used

Steel No.	Series	Heat No.	C	P	S	Mn	Cu	Si
1	A	3117	.11	.017	.029	.44	.185	.410
2	B	1462	.11	.015	.026	.43	.193	.010
3	C&D	2176	.17	.018	.031	.47	.189	.012

1. The figures appearing in parentheses refer to the bibliography appended to this paper.

✦ ✦ ✦

R. W. SANDELIN
Graduated from the University of Minnesota 1931; instructor in Metallurgy at the Georgia School of Technology 1931-1934; Metallurgist for the Atlantic Steel Company, Atlanta, Georgia, 1934 to date. Member of The Wire Association. Winner medal award 1940.

Microstructures of samples 1 through 6, Heat 3117, Series A (same for Series B); base composition as follows: C .11, P .017, S .029, Mn .44, Cu .185, Si .410.

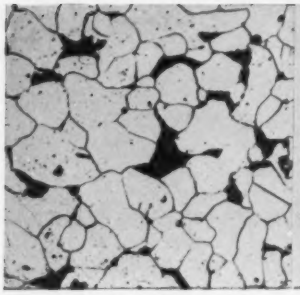

Figure 1. Microstructure of original 1½" hot rolled billet as received; Sample number 1. X250. ✦

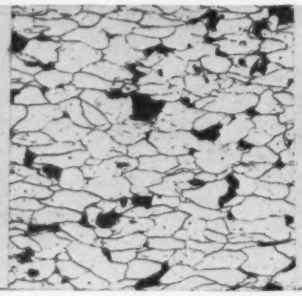

Figure 2. Microstructure of original 1½" billet wold worked to a 1¼" square; Sample number 2. X250. ✦

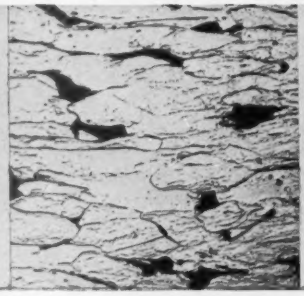

Figure 3. Microstructure of original 1½" billet cold worked to a 1" square; Sample number 3. X250. ✦

Figure 4. Microstructure of original 1½" billet cold worked to a ¾" square; Sample number 4. X250. ✦

Table I. Each Series was composed of ten different steels treated according to different methods to develop the microstructure desired.

✦ ✦ ✦

IN all cases the samples were obtained from 1½" billets, cut and precision ground to ½" x ½" x 6. After grinding, the surfaces of all test samples had a very smooth, polished finish.

✦ ✦ ✦

Figure 5. Microstructure of original 1½" billet cold worked to a ½" square; Sample number 5. X250. ✦ ✦ ✦

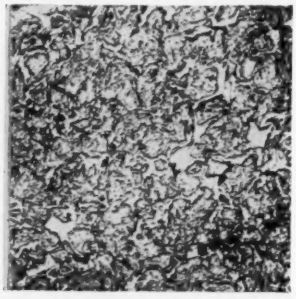

Figure 6. Microstructure of original billet heated to 1675° F., then quenched in cold water. X250. ✦

Microstructures of samples 7 through 10, Heat 3117, Series A (same for Series B); base composition as follows: C .11, P .017, S .029, Mn .44, Cu .185, Si .410.

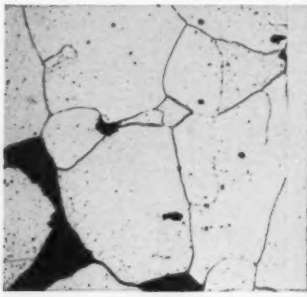

Figure 7. Microstructure of original 1½" billet, heated to 2200° F., for 1 hour and allowed to cool in furnace; Sample No. 7. X250. ✦ ✦

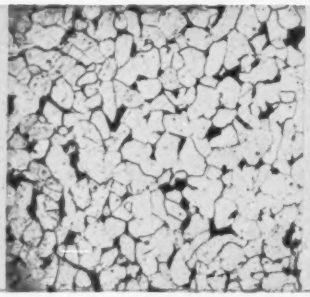

Figure 8. Microstructure of original 1½" billet, heated to 1675° F., then allowed to cool in air; Sample No. 8. X250. ✦ ✦ ✦

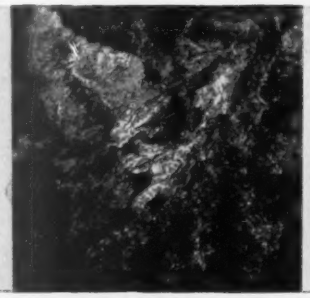

Figure 9. Microstructure of original 1½" billet, carburized for 36 hours at 1700° F., allowed to cool in box; Sample No. 9. X250. ✦ ✦

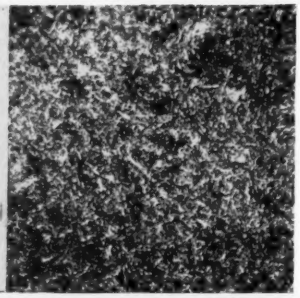

Figure 10. Microstructure of original 1½" billet, carburized, reheated to 1550° F., quenched in water; Sample No. 10. X250. ✦ ✦ ✦

Series A and B

THE twenty steels for this series of samples were obtained from Heats 3117 and 1462 respectively and have the base composition as indicated in Table I. These steels were treated as indicated in Table II.

✦ ✦ ✦

THE typical microstructures for each Series are shown in Figures 1 through 10. Only the microstructures for Series A are shown since those of Series B were identical.

✦ ✦ ✦

Series C and D

THE twenty steels in these series were obtained from Heat 2176 which had a base composition of C .17, P .015, S .031, Mn .47, Cu .187, Si .012. Steels 1 and 2 varied in copper content as shown in Table IV, all other analysis figures being the same as for the base composition. Steels 3, 4 and 5 varied in silicon content only, steels 6 and 7 varied in manganese, and steels 8 and 9 varied in phosphorus content.

✦ ✦ ✦

THE variation in analysis was accomplished by making ad-

ditions to the ingot molds as the heat was being poured. In this way only the desired element was varied all others being held essentially the same. The mold additions consisted of either ferro-alloys or the pure metals, added to the ingot molds as the heat was being poured. The 4000 pound ingot was later rolled into 1½" billets. From the middle of each of these ingots were cut two six-foot lengths from which the samples were obtained. The chemical analyses were made on drillings obtained from the billet samples.

✦ ✦ ✦

STEEL No. 10 was a sample taken from an ingot of the parent heat itself to which no additions had been made, and thus represents the base point in each of the individual groups in which comparisons were made.

✦ ✦ ✦

Series C and D

THE steels in Series C were all fine grained, this being accomplished by heating to 1650° F and cooling in air. The steels in Series D were all made coarse grained by heating to 2200° F for 1 hour and cooling in the furnace. The typical resulting microstructures for the fine and coarse grained steels are shown in Figures 11 and 12. Table III shows complete analyses and identity of the steels.

✦ ✦ ✦

Experimental Galvanizing Procedure

IN order to galvanize all of the samples in an identical manner it was necessary to place all of them in a specially constructed rack which held all of the samples upright and which could be manipulated by an overhead crane. This is the same method used in a previous investigation in which the effects of composition were studied (3). Figure 13 shows a typical sample; Figure 14 shows the rack with the samples held over the spelter pan prior to immersion. The rack for holding these samples was merely a frame

Table II

Series A & B

Base Composition—Series A (Heat No. 3117)	C	P	S	Mn	Cu	Si
	.11	.017	.029	.44	.185	.410
Base Composition—Series B (Heat No. 1462)	**C**	**P**	**S**	**Mn**	**Cu**	**Si**
	.11	.015	.026	.43	.193	.010

Sample No.	Type Steel	Treatment, Remarks
1	Billet as received	None, allowed to cool normally on cooling bed.
2	Cold worked	Cold forged from 1½" billet to 1¼" square. Reduction in area 27.4%.
3	Cold worked	Cold forged from 1½" billet to 1" square. Reduction in area 53.5%.
4	Cold worked	Cold forged from 1½" billet to ¾" square. Reduction in area 74.0%.
5	Cold worked	Cold forged from 1½" billet to ½" square. Reduction in area 88.3%.
6	Billet, hardened by water quench.	Billet heated 1675° F., quenched in cold water.
7	Coarse grain	Sample heated to 2200° F., for 1 hour, allowed to cool in furnace.
8	Fine grain	Sample heated to 1675° F., then cooled in air.
9	Carburized	Carburized for 36 hours at 1700° F., allowed to cool in carburizing box.
10	Carburized and hardened.	Carburized as above, reheated to 1550° F., quenched in cold water.

Microstructures of samples 1 through 10, Heat 2176, Series C and D, base composition as follows: C .17, P .018, S .031, Mn .47, Cu .189, Si .012.

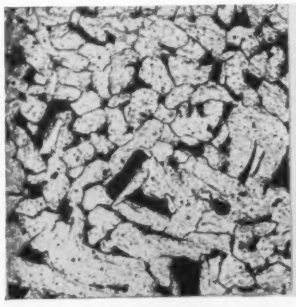

Figure 11. Microstructure of Series C, Heat 2176. Samples all fine grain as shown above. Samples heated to 1675° F. and cooled in air.

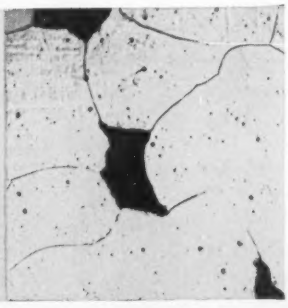

Figure 12. Microstructure of Series D, Heat 2176. Samples all coarse grain as above. Samples heated at 2200° F. for 1 hour, allowed to cool in furnace. ✦ ✦ ✦

Table III

Series C—Fine grain
Series D—Coarse grain

Base Composition: Heat 2176 (Sample 10)	C	P	S	Mn	Cu	Si
	.17	.018	.031	.47	.189	.012

No.	% Copper	No.	% Silicon	No.	% Manganese	No.	% Phosphorus
10	.189	10	.012	10	.47	10	.018
1	.375	3	.130	6	.75	8	.045
2	.675	4	.240	7	.87	9	.086
		5	.510				

constructed of light angle iron, the overall dimensions of the base being 24″ x 24″ square. The immersion times for galvanizing were: (1) 30 seconds, and (2) 180 seconds. In other words, one complete set was galvanized for ½ minute immersion, the other for 3 minutes.

✦ ✦ ✦

THESE immersion times were chosen since they represent the extremes in minimum and maximum galvanizing times ordinarily encountered in commercial practice with the shorter immersion times more nearly representing average practice. The procedure for galvanizing each rack of samples consisted of the following steps: (1) Immersion for 15 seconds in "Oakite," a commercial cleaner, for degreasing the samples, (2) rinse in cold running water, (3) immerse in H_2SO_4 at 160°F, commercial "Rodine" inhibitor used, for 5 seconds, (4) water rinse in cold running water to remove acid, (5) immerse in a zinc ammonium chloride, $ZnCl_2$ - 3 NH_4Cl, flux solution, 20° Be, 150°F, for 15 seconds, (6) allow to drain and dry, then (7) immerse in spelter at 850°F for 30 or 180 seconds, (8) allow to drain and permit coating to solidify over spelter pan, mill temperature 90°F with no wind effects, before removing rack from crane hook.

Figure 13. Typical sample for galvanizing tests, dimensions ½″ x ½″ x 6. All surfaces ground to same degree of smoothness. ✦ ✦

✦ ✦ ✦

"OAKITE" was used as a precautionary measure to remove any possible light grease or oil films resulting from handling the samples despite careful wiping with clean dry cloths. The acid pickle was necessarily very short and was merely another precautionary measure to insure a perfectly clean surface. The water rinses were made in a clear, constantly changing water to insure avoidance of contamination due to dissolved iron salts which sometimes occur when the water is not changed. Spelter temperature of 850°F was decided upon as representing average commercial practice.

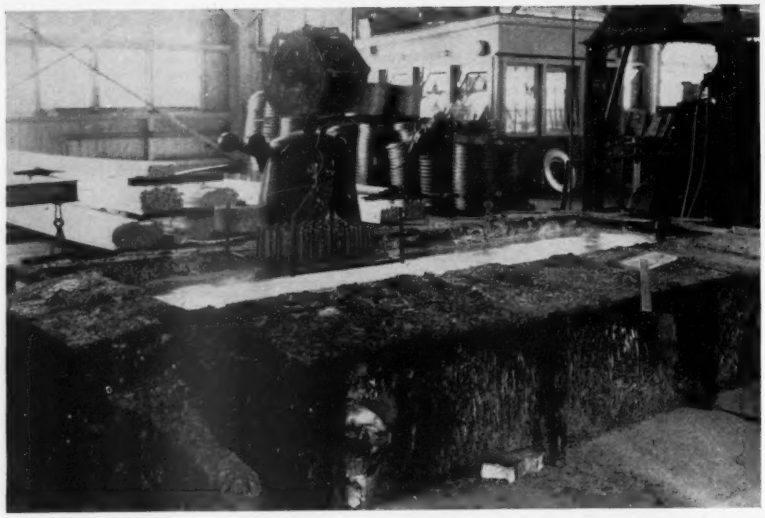

Figure 14. Rack holding samples just prior to immersion in the molten spelter. ✦ ✦

✦ ✦ ✦

Effects on Appearance — Series A

THE effects of cold work and various heat treatment upon the appearance of the galvanized test samples in Series A are summarized in Table IV:

✦ ✦ ✦

IN this series of steels which have the base composition as indicated, the tendency for ordinary hot-rolled samples would be to galvanize with smooth, dull gray coatings. This tendency for high-silicon steels was shown in previous work by the writer (3).

✦ ✦ ✦

THE effect of cold work on the appearance of a steel already high in silicon was nil. For the 3 minute tests there was a slight tendency for increased grayness at the extreme bottom of the sample which would indicate a slight tendency toward grayness.

✦ ✦ ✦

QUENCHING of a low carbon steel from temperatures above the upper critical as shown with sample No. 6 was without noticeable effect.

THE difference between the fine and coarse grain samples was not noticeable for the 30 second test; however for the 3 minute immersion it appeared that the fine grain steel had a slight tendency toward producing a bright coating.

✦ ✦ ✦

THE carburized samples proved to be very interesting. The difference between the slowly cooled and quenched samples was outstanding, the quenched or hardened sample being 100% bright with a smooth spangled finish whereas the slowly cooled sample was gray with a rough surface.

✦ ✦ ✦

Effects on Coating Weight — Series A

THE effect of increasing amounts of cold work or deformation was to increase the weight of the coating, this trend being more noticeable for the longer immersion time.

✦ ✦ ✦

THIS tendency is in accordance with the fact that cold deformation increases the diffusion rates of metals probably because it disturbs the lattice structure to the extent that interatomic exchange is made easier. It has been shown that hot-dip coatings are the results of an alloying action between the iron and zinc atoms

in which the iron atoms diffuse outward to form compounds or phases of much higher melting point than the pure zinc. The effect of cold deformation is to increase coating weight due to a higher diffusion rate resulting from a loosened or disturbed crystal lattice.

✦ ✦ ✦

THE effect of quenching the low carbon steel was without appreciable effect. The difference in coating weight between the fine and coarse grain samples was very slight however the coarse grain steels were somewhat heavier. A much greater difference in coating weights was observed on low silicon steels. It seems to be characteristic of the higher silicon steels to show much smaller coating weight differences between the fine and coarse grain samples. The same tendency was observed in Series C and D in which case the silicon steels showed very much smaller differences in coating weight than the other fine and coarse grain samples.

✦ ✦ ✦

THE carburized sample, No. 9, showed a tendency toward heavier coatings, particularly noticeable for the 3 minute immersion. The quenched sample, No. 10, had very much lower coating weight, at the 3 minute immersion the weight for the hardened sample being approximately ¼ that of the slowly cooled sample. This tremendous difference is of unusual interest. It would appear that the extreme rigidity of the lattice due to the hardening treatment inhibits the migratory tendency of the iron atoms to the extent that the alloying action with the zinc is materially reduced.

✦ ✦ ✦

TABLE V shows coating weights for all of the samples in Series A. Figures 15 and 16 show the effect of increasing amounts of cold work upon coating weight.

✦ ✦ ✦

Effects on Appearance — Series B

THE effects of cold work and the various forms of heat treatment on the appearance of the galvanized coatings are shown in Table VI:

✦ ✦ ✦

AS would be expected, the base composition of steels in this series normally galvanizes with a bright, spangled coating. This is characteristic of low-silicon, low-phosphorus steels as indicated in previous work (3).

✦ ✦ ✦

THE effect of increasing amounts of cold work had no noticeable effect upon the appearance of the coating. In every case

Table IV

Series A

	C	P	S	Mn	Cu	Si
Base Composition: Sample 1, Heat 3117	.11	.017	.029	.44	.185	.410

Appearance of Galvanized Coating

Sample	Type Steel	30 Seconds	180 Seconds
1	Billet as received	Dark gray, smooth	Lower 20% bright, remainder dark gray, smooth
2	Cold worked, 1½" to 1¼"	Dark gray, smooth	Lower 15% bright, remainder dark gray, smooth
3	Cold worked, 1½" to 1"	Dark gray, smooth	Lower 12% bright, remainder dark gray, smooth
4	Cold worked, 1½" to ¾"	Dark gray, smooth	Lower 8% bright, remainder dark gray, smooth
5	Cold worked, 1½" to ½"	Dark gray, smooth	Entirely dark gray, smooth
6	Billet, water quenched	Dark gray, smooth	Lower 5% bright, remainder dark gray, smooth
7	Coarse grained sample	Dark gray, smooth	Lower 5% bright, remainder dark gray, slightly rougher than above sample
8	Fine grained sample	Dark gray, smooth	Lower 20% bright, remainder dark gray, smooth
9	Carburized, as received	Light gray, smooth	Light gray, surface was noticeably very rough
10	Carburized and hardened	100% bright, shiny, spangled	100% bright, shiny, spangled

Table V

Series A

	C	P	S	Mn	Cu	Si
Base Composition: Sample 1, Heat 3117	.11	.017	.029	.44	.185	.410

Weight of Coating, Oz./sq. ft.

Sample	Type Steel	30 Seconds	180 Seconds
1	Billet as received	1.1896	3.4910
2	Cold worked 1½" to 1¼"	1.2331	3.5707
3	Cold worked, 1½" to 1"	1.2505	3.6733
4	Cold worked, 1½" to ¾"	1.2736	3.9163
5	Cold worked, 1½" to ½"	1.2774	4.2726
6	Billet, water quenched	1.0660	3.2832
7	Coarse grained sample	1.1578	3.5246
8	Fine grained sample	1.1349	3.3639
9	Carburized, as received	1.5547	5.9606
10	Carburized and hardened	0.9892	1.5100

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Greater Production and Lower Costs

Many wire and wire products plants have learned that handling materials overhead with Cleveland Tramrail really is the *modern way* which increases production and lowers costs.

Every year more rod producers and fabricators are added to the growing list of Cleveland Tramrail customers. Every year old satisfied customers extend their Tramrail installations.

1941 has been no exception to the trend. Many block stripping cranes and carriers have been installed. More cleaning house cranes have been purchased—bringing the total up to 27 installations. Other wire and rod handling equipment has been erected or is on order.

Of great importance to those companies operating at peak capacity is the fact that an installation of Cleveland Tramrail often eliminates the need for plant expansion because Tramrail equipment aids production, increases storage capacity and makes use of remote out-of-the-way spaces.

It will pay you to discuss this modern way of handling with your local Cleveland Tramrail representative.

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THE CLEVELAND CRANE & ENGINEERING CO.
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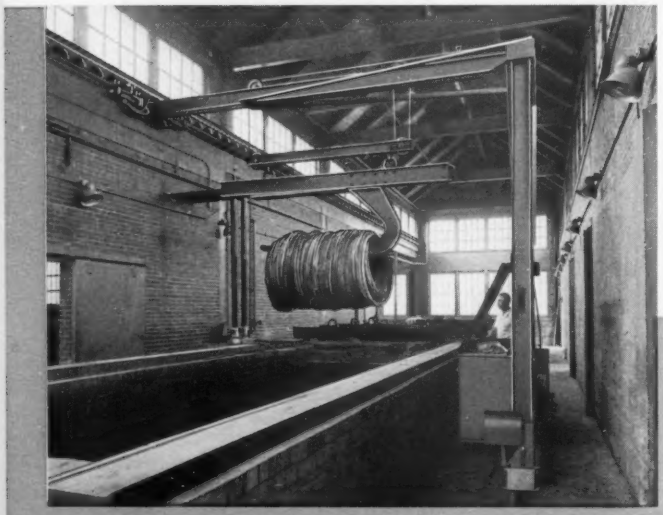
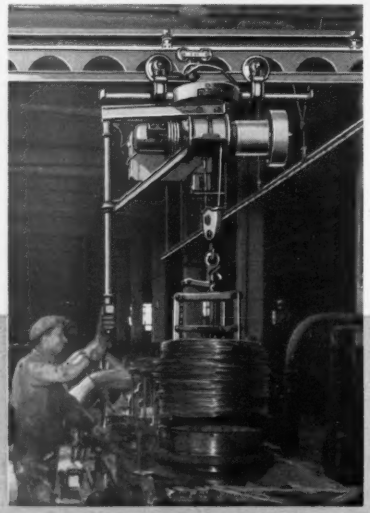
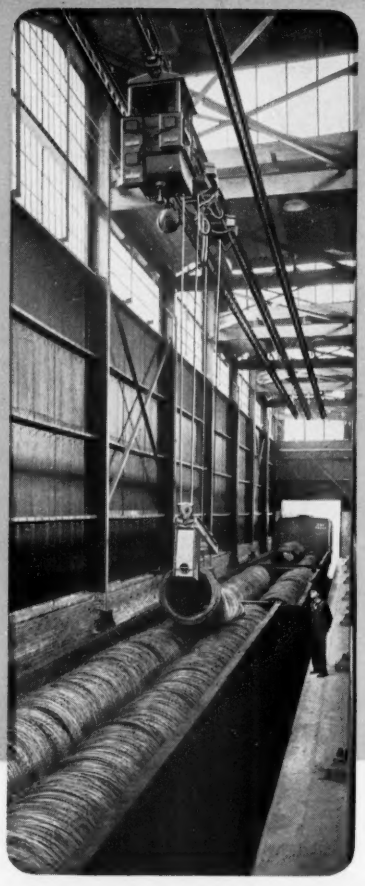


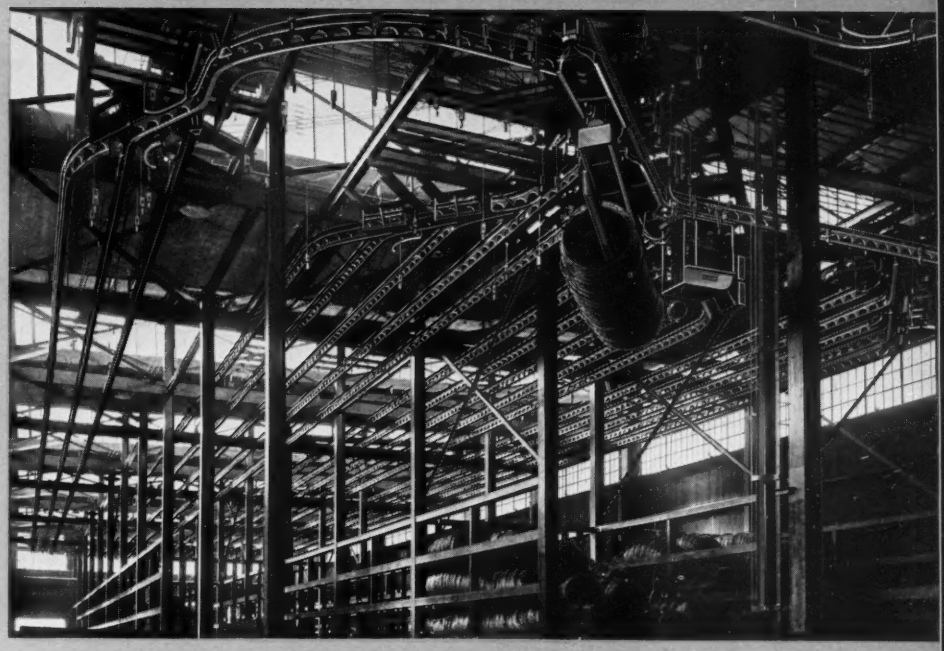
Cleveland Tramrail cleaning house cranes handle 50 to 450 tons in 24 hours. They save floor space—up to 80%.



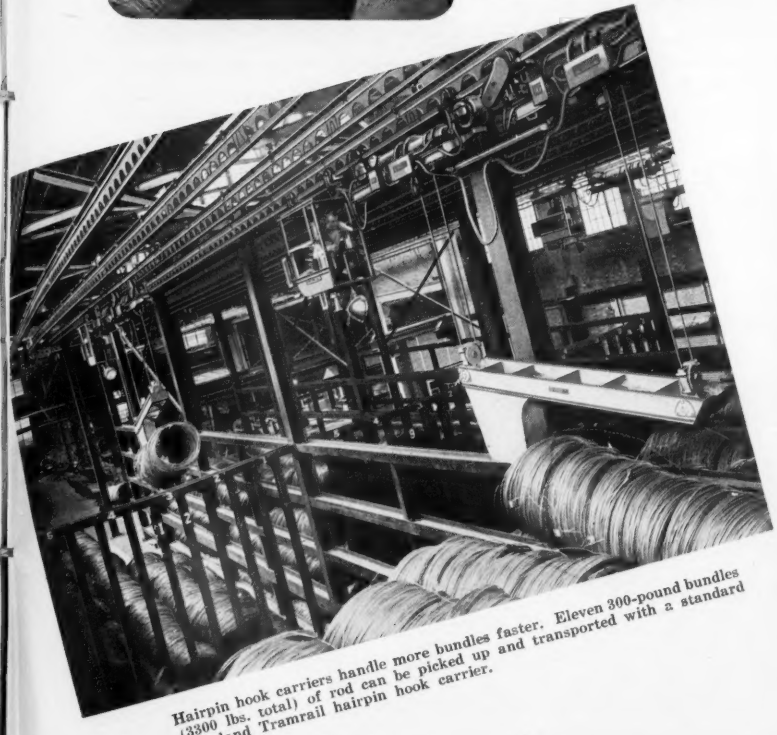
Block strippers—internal and external—are available for modern or old style blocks. They permit one man to take care of 2 to 6 blocks.



It is simple to load and unload railroad cars with a Cleveland Tramrail system and hairpin hook. This shows how many leading plants are doing it.

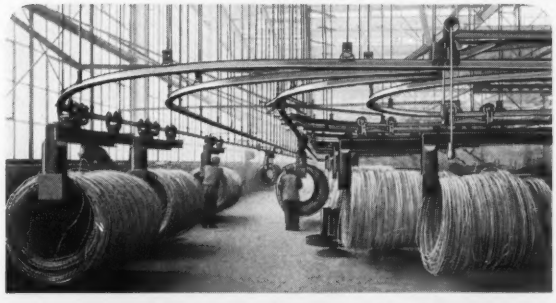


A Cleveland Tramrail system as illustrated above introduces high-degree efficiency which cuts out lost motion and waste space. The bundles are picked up, transported and set in place by means of controls in the Tramrail hairpin-hook-carrier cab. The operator, without floor assistants, does it all electrically. Because aisles are not required and bundles can be piled higher, the capacity of a storage area is greatly increased with Cleveland Tramrail.



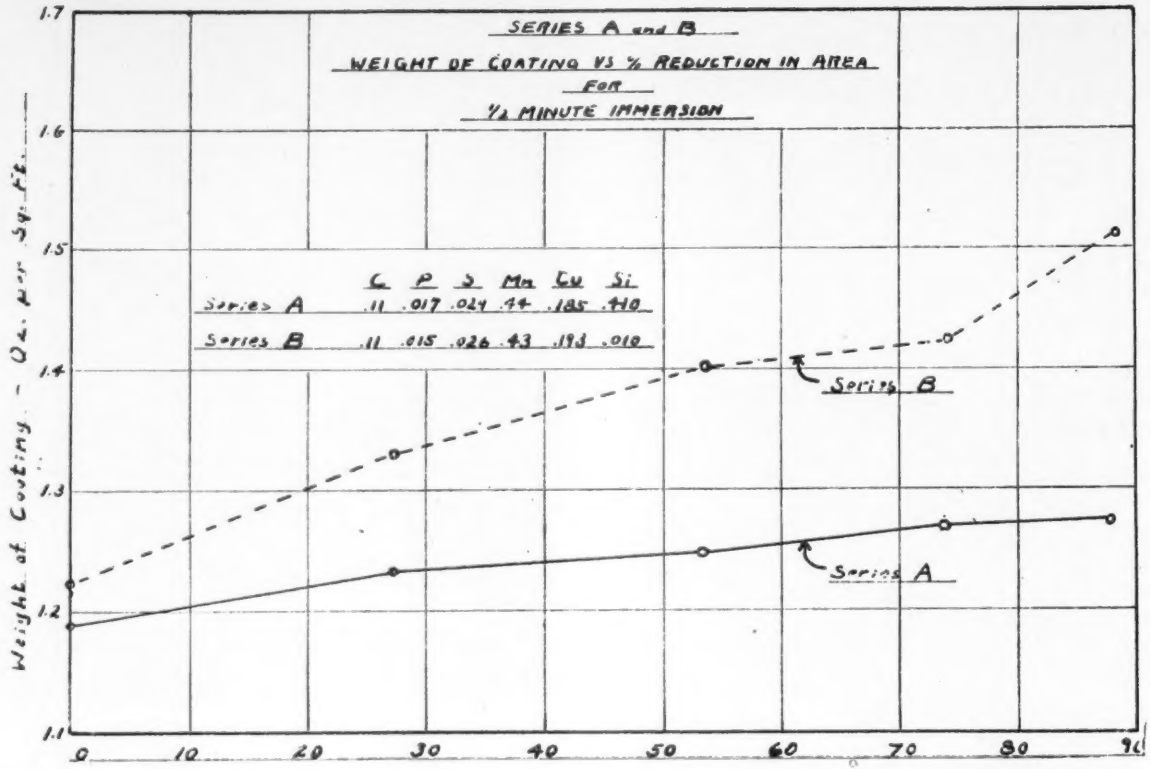
Hairpin hook carriers handle more bundles faster. Eleven 300-pound bundles (3300 lbs. total) of rod can be picked up and transported with a standard Cleveland Tramrail hairpin hook carrier.

Cleveland Tramrail rod handling systems can be as simple or extensive as desirable, either hand or electrically operated. The carriers below are hand propelled.



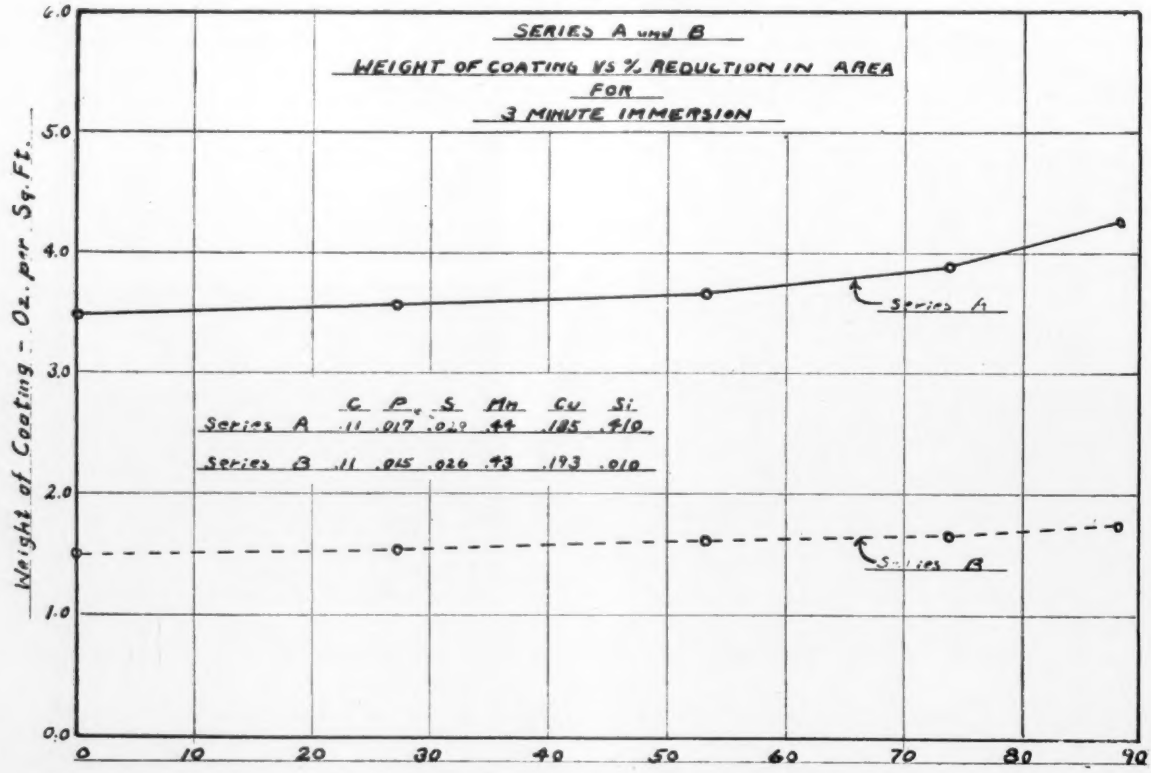
A few of a battery of Cleveland Tramrail block-stripping cranes in a modern plant. The carriers are provided with rigid arms which make them easy to propel. Conveniently located in the lower extremity of the arms are push-buttons for controlling the hoists.

CLEVELAND TRAMRAIL



Per Cent Reduction in Area by Cold Work

Figure 15-a



Per Cent Reduction in Area by Cold Work

Figure 15-b

the coating had a bright, shiny, spangled appearance.

✦ ✦ ✦

THE quenched low carbon samples were unchanged in appearance for both the 30 second and 3 minute immersions.

✦ ✦ ✦

THE coarse grain sample for the 30 second immersion was entirely dark gray in appearance, at the 3 minute immersion it appeared bright and shiny although slightly rougher. This unusual behavior lead to a further investigation of this effect. Data presented in Series D showed the same results.

✦ ✦ ✦

THE fine grane samples were unchanged in appearance. The carburized sample was bright but had a considerably rougher surface than other samples. The carburized and hardened sample had a smooth, bright, shiny spangled finish.

✦ ✦ ✦

Effects on Coating Weight — Series B

INCREASED amounts of cold work resulted in increased coating weight. The effect was more pronounced in this series of steels than in Series A.

✦ ✦ ✦

THE quenched low-carbon sample showed no change in coating weight from that of the base sample No. 1.

✦ ✦ ✦

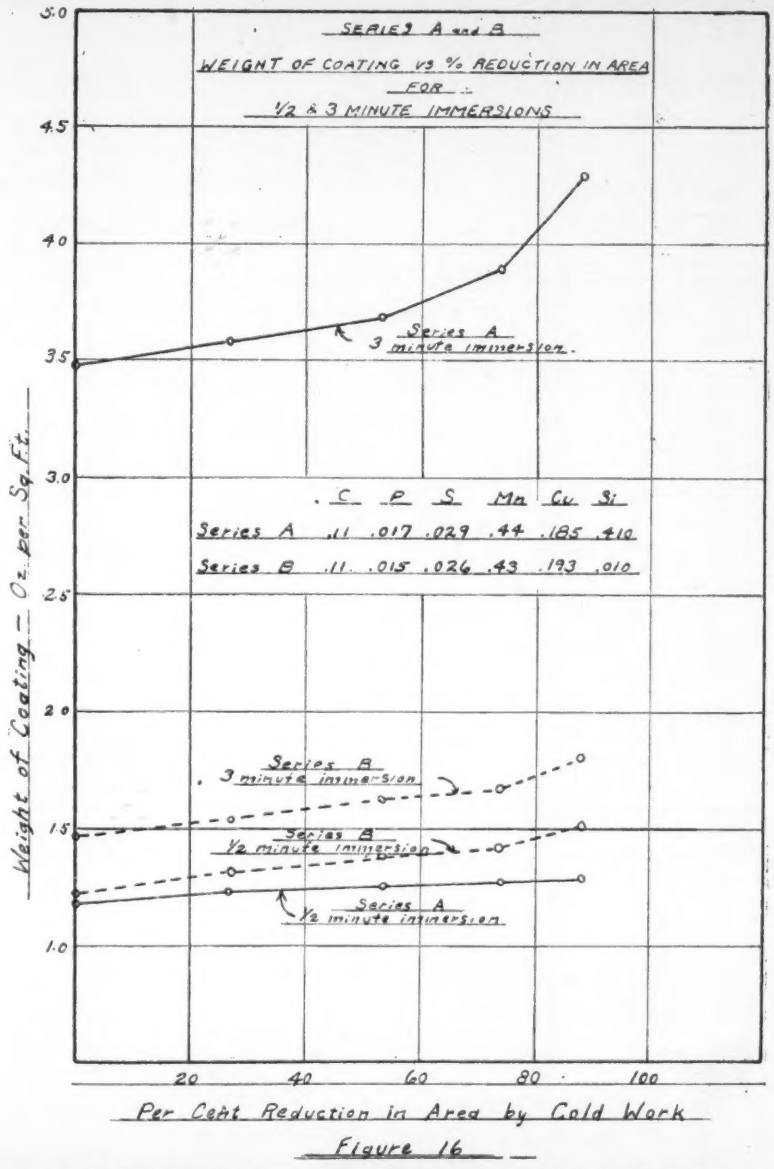


Figure 16

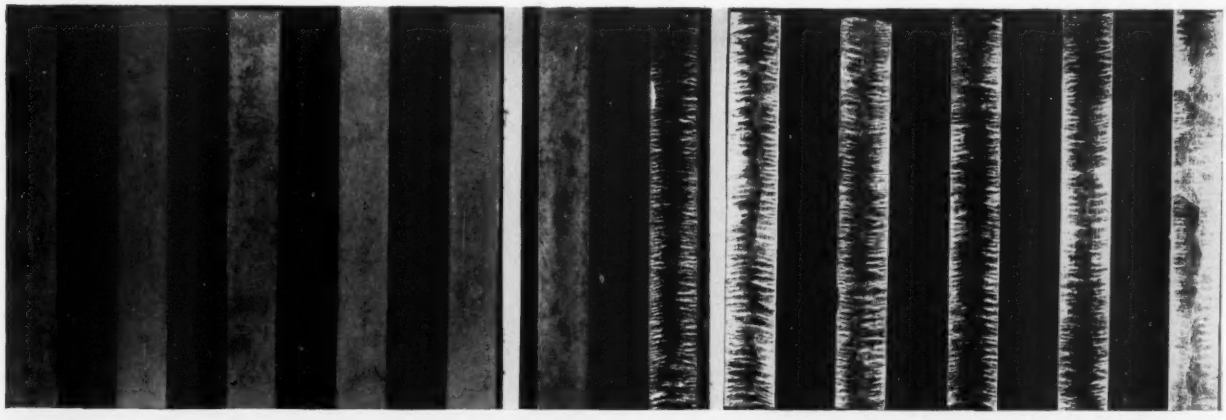


Figure 17. ✦ ✦ ✦ ✦ ✦ Figure 18. ✦ Figure 19. ✦ ✦ ✦ ✦ ✦ ✦

Figure 17. Left to right, sample Nos. 1, 2, 3, 4 and 5; Series A, 30 second immersion. Composition of the base sample No. 1, is as follows: C .11, P .017, S .029, Mn .44, Cu .185, Si .410%. Sample 1 is the hot rolled billet whereas samples 2, 3, 4 and 5 differ only from the base sample in having been cold worked. Samples 2, 3, 4 and 5 were cold worked from 1½" billets to 1¼", 1", ⅞" and ½" squares respectively. Note that cold work did not have any brightening tendency and the appearance of the coatings are unchanged. Figure 18. Left to right, Sample Nos. 9 and 10. Series A 30 second immersion. Sample 9 was carburized for 36 hours at 1700° F., and allowed to cool in the carburizing box. Sample 10 was carburized as described above, then reheated to 1550° F., and quenched in cold water to harden the surface. The object of carburizing was to determine the effect of increasing the carbon content of the surface upon galvanizing. Note that only the hardened sample galvanized with a bright shiny coating. The sample which was only carburized and not hardened behaved like the rest of the samples in this series, namely, that it galvanized with a gray coating. This hardened sample galvanized with a bright coating at the long immersion time also. The composition of the base sample before carburizing was as follows: C .11, P .017, S .029, Mn .44, Cu .185 Si. 410%. Figure 19. Left to right, samples Nos. 1, 2, 3, 4 and 5; Series B, 30 second immersion. Composition of the base sample, No. 1, is as follows: C .11, P .015, S .026, Mn .43, Cu .193, Si .010%. Sample 1 is the hot rolled billet whereas samples 2, 3, 4 and 5 differ only from the base sample in having been cold worked. Samples 2, 3, 4 and 5 were cold worked from 1½" billets to 1¼", 1", ¾" and ½" squares respectively. Note that cold work did not have any graying effect upon the appearance of the coatings. Sample 5, shown on the extreme right was slightly rougher and a shade less bright than the other samples. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

Table VI

Series B

	C	P	S	Mn	Cu	Si
Base Composition: Sample 1, Heat 1462	.11	.015	.026	.43	.193	.010

Appearance of Galvanized Coating

Sample	Type Steel	30 Seconds	180 Seconds
1	Billet, as received	Bright, shiny, spangled	Bright, shiny, spangled
2	Cold worked, 1½" to 1¼"	Bright, shiny, spangled	Bright, shiny, spangled
3	Cold worked, 1½" to 1"	Bright, shiny, spangled	Bright, shiny, spangled
4	Cold worked, 1½" to ¾"	Bright, shiny, spangled	Bright, shiny, spangled
5	Cold worked, 1½" to ½"	Bright, shiny, spangled, but slightly less bright than sample above, hardly noticeable	Bright, shiny, spangled
6	Billet, water quenched	Bright, shiny, spangled	Bright, shiny, spangled
7	Coarse grained sample	Entirely dark gray, smooth	Bright, shiny, spangled, rougher than above samples
8	Fine grained sample	Bright, shiny, spangled	Bright, shiny, spangled, rougher than above samples
9	Carburized, as re-received	Bright, shiny, considerably rougher than above	Bright, shiny, considerably rougher than above
10	Carburized and hardened	Bright, shiny, spangled	Bright, shiny, considerably rougher than above

Table VII

Series B

	C	P	S	Mn	Cu	Si
Base Composition: Sample 1, Heat 1462	.11	.015	.026	.43	.193	.010

Weight of Coating, Oz./sq. ft.

Sample	Type Steel	30 Seconds	180 Seconds
1	Billet as received	1.2207	1.4966
2	Cold worked, 1½" to 1¼"	1.3318	1.5155
3	Cold worked, 1½" to 1"	1.4001	1.6350
4	Cold worked, 1½" to ¾"	1.4262	1.6738
5	Cold worked, 1½" to ½"	1.5170	1.7855
6	Billet, water quenched	1.2213	1.5121
7	Coarse grained sample	1.3703	1.8913
8	Fine grained sample	1.1349	1.4809
9	Carburized, as received	1.1869	1.2756
10	Carburized and hardened	0.7866	1.2020

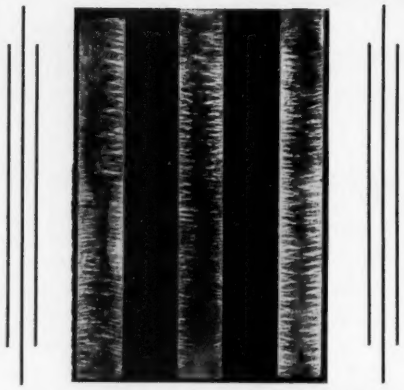


Figure 22. Left to right, sample Nos. 8, 1 and 7, Series B, 180 second immersion. Composition of the base sample, No. 1, is as follows: C .11, P .015, S .026, Mn .43, Cu .193, Si .010%. Samples 8, 1 and 7 vary in grain size only, being fine, medium and coarse grain steels respectively. Note that at the longer immersion time the coarse grained sample galvanized with a bright coating.

THE coarse grain steel had a considerably heavier coating than the fine grain samples. In fact, taking sample No. 8 as fine grain, sample No. 1 as medium grain-size steel, and sample No. 7 as coarse grain, we note a progressive increase in coating weight, namely; 1.1349, 1.2207 and 1.3703 oz./sq. ft. respectively for the ½ minute immersion, and 1.4809, 1.4966 and 1.8913 oz./sq. ft. respectively for the 3 minute immersion.

✦ ✦ ✦

THE carburized samples in this series showed lower coating weights than the base sample for both the ½ and 3 minute immersions. The carburized and hardened samples showed the lowest coating weights of any of the samples in the series.

✦ ✦ ✦

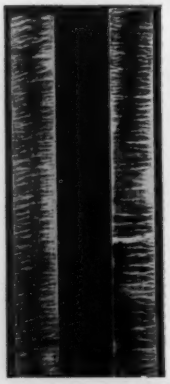


Figure 20. Left to right, samples Nos. 9 and 10, Series B, 30 second immersion. Sample 9 was carburized for 36 hours at 1700° F., and allowed to cool in the carburizing box. Sample 10 was carburized as described above, then reheated at 1550° F., and quenched in cold water to harden the surface. The object of carburizing was to determine the effect of increasing the carbon content of the surface upon galvanizing. Both samples galvanized with bright coatings, however the hardened sample had a very much smoother coating than the other sample which was merely carburized but not hardened. The composition of the base sample before carburizing was as follows: C .11, P .015, S .026, Mn .43, Cu .193, Si .010%. After carburizing the carbon content of the case was quite high being of approximately eutectoid composition as determined metallographically. ✦

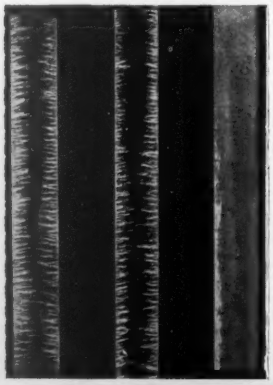


Figure 21. Left to right, sample Nos. 8, 1 and 7, Series B, 30 second immersion. Composition of the base sample, No. 1, is as follows: C .11, P .015, S .026, Mn .43, Cu .193, Si .010%. Samples 8, 1 and 7 vary in grain size only, being fine, medium and coarse grain steels respectively. Figures 8, 1 and 7 show the microstructures for these steels. Note that at the short immersion time of 30 seconds the coarse grained steel galvanized with a dull gray coating. ✦ ✦

IN order to make a more thorough study of the effect of grain size on various types of steels the samples in Series C and D were prepared in fine and coarse grain sizes. The fine grain corresponded to that shown in Figure 11 while the coarse grain steels had a grain size as indicated in Figure 12. Thus it was possible to observe the effect of grain size appearance and coating weight on steels varying in copper, silicon, manganese and phosphorus content.

✦ ✦ ✦

Effects on Appearance — Series C

THE appearance of the various fine grain test samples are summarized in Table VIII. The base sample, No. 10, being low in silicon and phosphorus content normally galvanizes with a bright, smooth spangled finish. The results obtained were in every respect similar to those obtained in previous work concerning the specific effects of composition on appearance. The high silicon and high phosphorus steels showed gray coatings for the short immersion time. Copper and manganese had no effect upon the appearance of the base sample. The samples galvanized for 3 minutes were somewhat rougher than those galvanized for ½ minute.

✦ ✦ ✦

Effects on Appearance — Series D

THE effect of coarsening the grain size was quite marked in that the tendency toward producing gray coatings was greatly increased. Data on appearance are shown in Table IX. As has been previously noted, increased immersion time tends to produce bright coatings, this being due to increased coating thickness which permits a pure zinc layer to freeze on the outside before alloying is complete. Bright, spangled coatings always have a pure zinc layer on the outside whereas gray coatings are always composed entirely of iron-zinc alloy layers.

Table VIII

Series C
Fine Grain Steels

	C	P	S	Mn	Cu	Si
Base Composition: (Heat 2176, Sample 10)	.17	.018	.031	.47	.189	.012

Appearance of Galvanized Coating

Sample	Analysis	30 Seconds	180 Seconds
10	.189% Cu.	Bright, shiny, spangled	Bright, shiny, spangled
1	.375% Cu.	Bright, shiny, spangled	Bright, shiny, spangled
2	.675% Cu.	Bright, shiny, spangled	Bright, shiny, spangled
10	.012% Si.	Bright, shiny, spangled	Bright, shiny, spangled
3	.130% Si.	Dark gray, lower 8% bright	Dark gray, lower 10% bright
4	.240% Si.	Dark gray, lower 30% bright	Lower 70% bright
5	.510% Si.	Entirely dark gray	Entirely dark gray
10	.47% Mn.	Bright, shiny, spangled	Bright, shiny, spangled
6	.75% Mn.	Bright, shiny, spangled	Bright, shiny, spangled
7	.87% Mn.	Bright, shiny, spangled	Bright, shiny, spangled
10	.018% P.	Bright, shiny, spangled	Bright, shiny, spangled
8	.045% P.	Bright, semi-lustrous, streaked, no spangle	Bright, streaked, spangle barely discernible
9	.086% P.	Entirely dark gray	Bright, streaked, spangle barely discernible

THOSE of the 3 minute immersion samples which galvanized with bright coatings were much rougher than the corresponding 3 minute samples in the fine grain steels.

✦ ✦ ✦

THE microstructure of ordinary hot rolled steel sections insofar as grain size is concerned would show either fine or medium grain size. Therefore, it would appear that chemical composition would be a more important factor than grain size except under unusual conditions since under normal conditions an extremely coarse grain would not be desirable.

✦ ✦ ✦

THE behavior of the various steels in Series A, B and C in regard to their galvanizing characteristics were the same as observed in a previous investigation (3); namely, that varying amounts of copper and manganese have little or no effect upon coating weight and appearance, and that silicon and phosphorus produce gray coatings under certain conditions.

✦ ✦ ✦

FIGURE 23 through 30 show the appearance of the various sets of steels in Series C and D, galvanized for 30 seconds. Note the decided tendency toward producing gray coatings in the coarse grain (Series D) steels.

✦ ✦ ✦

Effects on Coating Weight — Series C and D

THE coating weights for the various samples in Series C and D are summarized in Table X. The obvious effect of increased grain size is to increase coating weight. This fact can be readily observed by comparison of data in Table X. It is interesting to note that the difference in coating weight was not a constant factor but varies with the type of steel; for example, the increase in coating weight due to coarsening of grain size was least in the case of the silicon steels and greatest in the case of the high-phosphorus steels for the 3 minute immersion. The coating weights for the fine grain steels followed the same trends as observed in previous investigations.

✦ ✦ ✦

Final Discussion and Summary

DATA presented in connection with the present investigation reveal that in addition to the ef-

Table IX

Series D
Coarse Grain Steels

	C	P	S	Mn	Cu	Si
Base Composition: (Heat 2176, Sample 10)	.17	.018	.031	.47	.189	.012

Appearance of Galvanized Coating

Sample	Analysis	30 seconds	180 Seconds
10	.189% Cu.	Two sides gray; other two sides gray near top, semi-lustrous near bottom; no spangle whatever — definitely a gray sample although not as gray as ordinarily encountered. Surface rough on semi-lustrous area.	Bright, shiny, indistinct spangle, rough, streaked
1	.375% Cu.	Same as above	Same as above
2	.675% Cu.	Same as above except somewhat brighter	Same as above
10	.012% Si.	Two sides gray, other two sides gray near top, see description above.	Bright, shiny, indistinct spangle, rough, streaked
3	.130% Si.	Dark gray, lower 10% bright	Dark gray, lower 10% bright
4	.240% Si.	Dark gray, lower 25% bright	Entirely bright with semi-lustrous appearance, spangle hardly discernible, surface slightly roughened
5	.510% Si.	Dark gray, lower 5% bright	Entirely gray, lower 5% bright
10	.47% Mn.	Two sides gray, other two sides gray near top, see description above	Bright, shiny, indistinct spangle, rough, streaked
6	.75% Mn.	Same as above	Same as above
7	.87% Mn.	Entirely gray on all sides, lower 10% bright	Same as above except slightly rougher surface
10	.018% P.	Two sides gray, other two sides gray near top, see description above	Bright, shiny, indistinct spangle, rough, streaked
8	.045% P.	Entirely dark gray	Same as above except rougher and more streaked
9	.086% P.	Entirely dark gray	Entirely light gray with pitted surface

fects of the chemical composition of the steel, other factors affect such galvanizing properties as appearance of the coating and weight of coating. The factors under consideration in the present study were cold deformation, varying grain size and heat treatment. The presence of certain elements in the steel, notably silicon, influences the magnitude of the effect of the factors mentioned above. The difference exhibited in coating weight between the carburized samples, No. 9, in Series A and B for the 3 minute immersion was particularly outstanding.

✦ ✦ ✦

THE low coating weights obtained with the carburized and hardened samples, No. 10, indicate that the microstructure of the steel can and does, in some cases, play an important role in affecting coating weight.

✦ ✦ ✦

IN regard to grain size, the results were somewhat different than anticipated in that it was thought that the fine grain steels would show increased coating weights and a tendency toward gray coatings. The reason for this assumption is that increased diffusion rates are usually associated with finer grained aggregates. However, for the steels prepared in the manner as previously indicated, the coarse grained steel showed increased diffusion rates as indicated by increased alloying

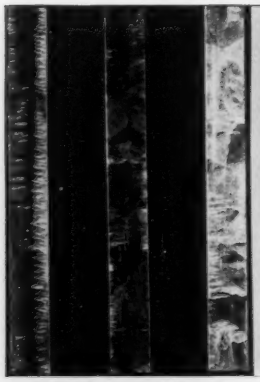


Figure 23. Left to right, sample Nos. 10, 1 and 2 Series C (fine grain). Note that all samples galvanized with bright, smooth, spangled coatings. 30 second immersion. ✦ ✦

Figure 24. Left to right, sample Nos. 10, 1 and 2 Series D (coarse grain), same steels as shown in Figure 23 except for grain size. Note that increase in grain size caused graying and roughening of coating. 30 second immersion. ✦ ✦

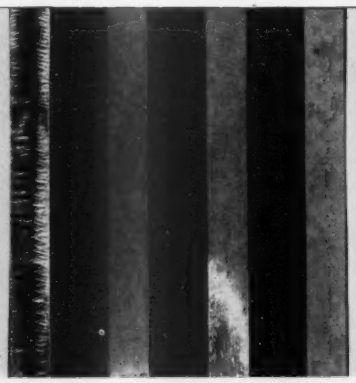


Figure 25. Left to right, sample Nos. 10, 3, 4 and 5, Series C (fine grain). Addition of silicon produces gray coatings.

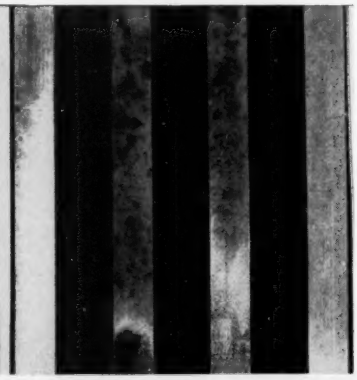


Figure 26. Left to right, sample Nos. 10, 3, 4 and 5, Series D (coarse grain), same steels as shown in Figure 25 except for grain size. No effect noticeable on samples 3, 4 and 5 since they tend to galvanize gray due to high silicon content. ✦

action which produced the heavier coating weights.

✦ ✦ ✦

THE following statements summarize the effects of cold deformation, grain size, and heat treatment upon the properties of a hot-dip galvanized coating. This summary is based upon the conditions of the experimental methods described herein. Under these conditions all of the effects described are reproduceable. However, differences in size and shape of section being galvanized, temperature of spelter, cooling effects, if any; nature of wipes, if any; condition of surface, whether smooth or rough, rate of emergence from spelter, general conditions of pickling and fluxing and possibly other factors, all have a bearing upon the resultant properties of the coating.

✦ ✦ ✦

SUMMARY

I — Effect Upon Appearance

1. Cold deformation had no appreciable effect upon the appearance of the coatings for either low-silicon or high-silicon steels. That is, the low-silicon steels galvanized with bright, shiny, spangled coatings regardless of the amount of cold work while the high-silicon samples all had the anticipated dark gray coatings.
2. Fine or medium grain size steel, such as ordinarily obtained on hot-rolled products, have no appreciable effect on appearance; low-silicon steels galvanize with bright coatings and high-silicon steels galvanize with dark gray coatings, particularly so for the shorter immersion times.
Coarse grain steels such as obtained on prolonged annealing at abnormally high temperatures produces gray coatings on steels which would ordinarily galvanize with a bright, spangled coating. This effect is only noticeable for the short immersion times. For the long immersion time of 3 minutes the coatings are bright although rough. The bright coatings are the results of increased coating thickness or weight which prevents the alloying action from becoming complete at the surface, thus producing a dark gray, iron-zinc alloy surface.
For the high-silicon steels which normally galvanize with gray coating the effect of coarse grain size was not noticeable since the effect of coarse grain is to produce the same type of coating.
3. The low-carbon steels quenched in water from hardening temperatures were unchanged in their appearance; their coating appearance was the same as the base sample.
4. The appearance of the coating of the carburized samples from the high-silicon steel was essentially the same as the base sample, that is, with a gray finish. The same was true of the carburized sample from the low-silicon steel; the appearance being bright although with a somewhat rougher finish.
5. The carburized samples which were hardened by quenching in water from the hardening temperature

Table X

Series C and D

	C	P	S	Mn	Cu	Si
Base Composition: Heat 2176, Sample 10)	.17	.018	.031	.41	.189	.012

Weight of Coating, Oz./Sq. Ft.

		30 Seconds		180 Seconds	
Sample	Analysis	Fine Grain	Coarse Grain	Fine Grain	Coarse Grain
10	.189% Cu.	1.369	1.530	1.739	2.312
1	.375% Cu.	1.347	1.543	1.648	2.110
2	.675% Cu.	1.312	1.529	1.659	2.140
10	.012% Si.	1.369	1.530	1.739	2.312
3	.130% Si.	1.253	1.256	2.895	2.920
4	.240% Si.	1.180	1.183	2.384	2.475
5	.510% Si.	1.305	1.370	3.645	3.978
10	.47% Mn.	1.369	1.530	1.739	2.312
6	.75% Mn.	1.358	1.569	1.726	2.920
7	.87% Mn.	1.362	1.538	1.740	2.615
10	.018% P.	1.369	1.530	1.739	2.312
8	.045% P.	1.580	1.711	2.140	4.290
9	.086% P.	1.631	1.810	3.580	4.860

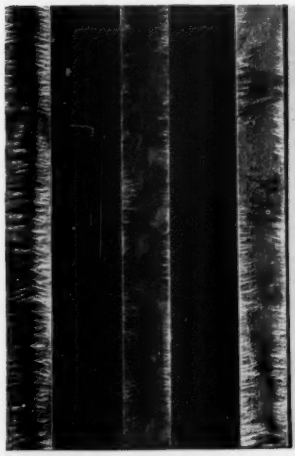


Figure 27. Left to right, sample Nos. 10, 6 and 7, Series C (fine grain). All samples galvanized with bright, smooth, spangled coatings. ✦

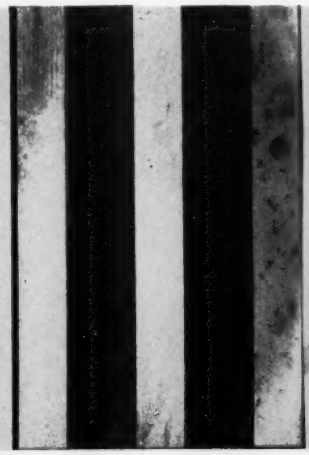


Figure 28. Left to right, sample Nos. 10,, 6 and 7, Series D (coarse grain) same steels as shown in Figure 27 except for grain size. Note tendency to galvanize with gray coatings due to coarsening of grain size. ✦

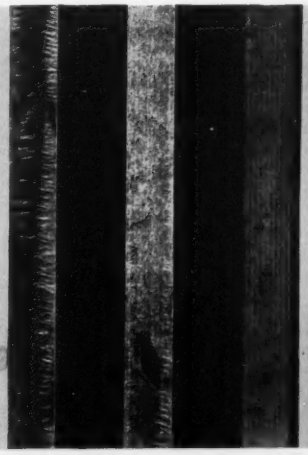


Figure 29. Left to right, sample Nos. 10, 8 and 9, Series C (fine grain) Increase in phosphorus content produces gray coatings. ✦ ✦

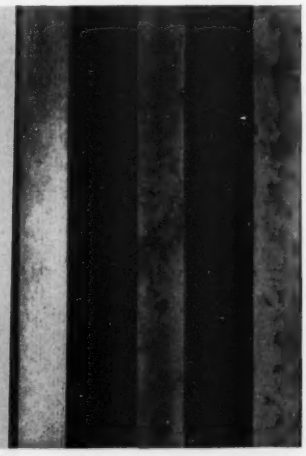


Figure 30. Left to right, sample Nos. 10, 8 and 9, Series D, (coarse grain), same steels as shown in Figure 29 except for grain size. Note that all samples are gray whereas in Figure 29, sample 10 was bright, smooth and spangled and sample 8 had a semi-lustrous slightly roughened finish. ✦

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galvanized with bright, shiny, smooth coatings for both the ½ and 3 minute immersions. This was particularly remarkable in the case of the high-silicon steels since this sample was the only one in the entire set which had a bright, smooth, spangled finish, all of the others being gray.

6. In Series C, the usual effects of composition were observed, namely, that neither copper nor manganese affect coating appearance, silicon produces gray coatings although in the range of approximately .20 - .25% Si a brightening tendency is noted for the long immersion time. Phosphorus also produces gray coatings when present in large amounts.

✦ ✦ ✦

II — Effect Upon Coating Weight

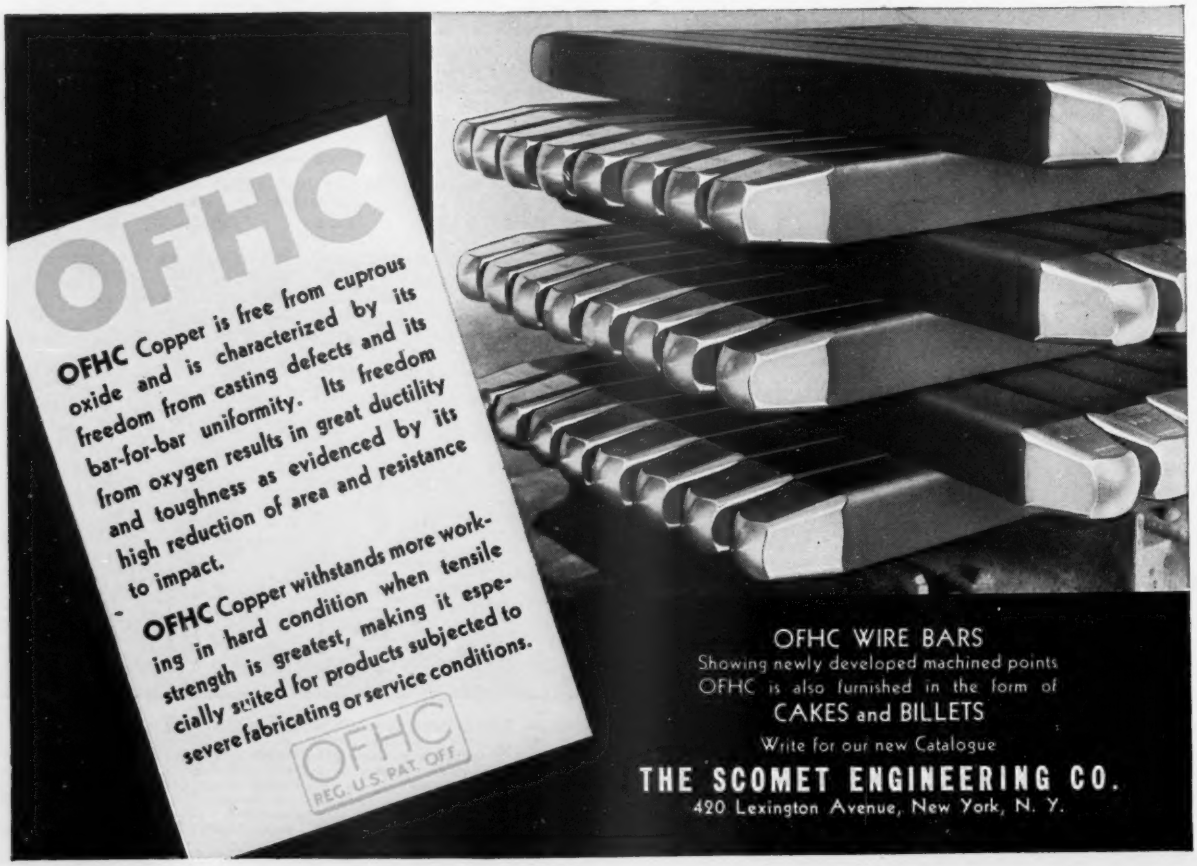
1. Cold deformation increased coating weight slightly.
2. Coarse grain steels showed considerable increase in coating weight over the corresponding fine grain samples, the effect being more noticeable for the longer immersion time of 3 minutes.

   The effect of grain size was least noticeable in the case of the high-silicon steels and most noticeable in the case of the high-phosphorus samples.
3. Low-carbon steels quenched in water from hardening temperatures show no change in coating weight.
4. Carburized, low-silicon steels, show no appreciable change in coating weight. Carburized, high-silicon steels, show considerable increase in coating weight for ½ minute immersion and a tremendous increase in weight for 3 minute immersion.
5. The carburized and hardened samples were unique in showing very low coating weights for both ½ and 3 minute immersions. The coating weights on the high-silicon samples were slightly higher than for the low-silicon steels.

✦ ✦ ✦

Bibliography

(1) Bablik, H., "Galvanizing," 2nd Ed., pp 155, E. & F. N. Spon, Ltd., London.
(2) von Schwarz, M., and Fromm, H., "Galvanizing Defects on Steel Sheets Because of Defective Base Material," Korrosion & Metallschutz, vol. 11, 241.
(3) Sandelin, R. W., "Galvanizing Characteristics of Different Types of Steel," Wire and Wire Products, vol. 15, 655, 721, vol. 16, 28.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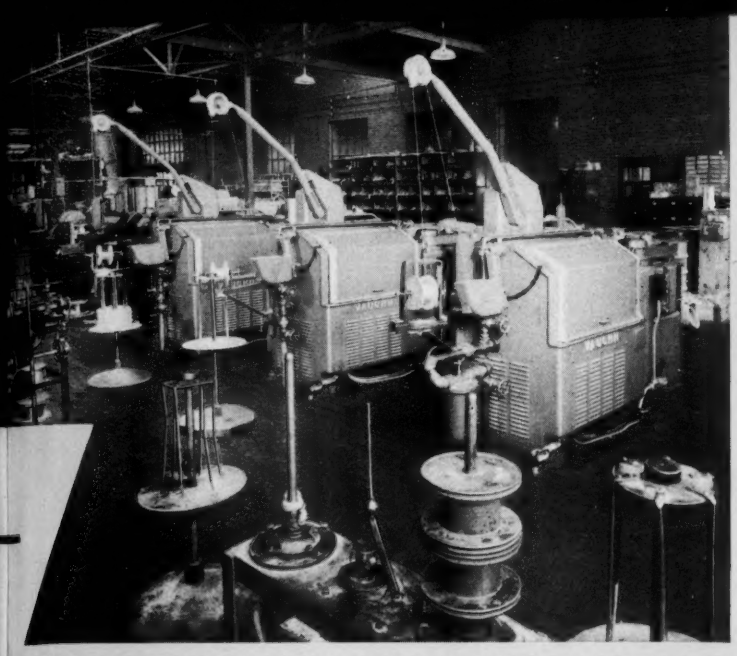

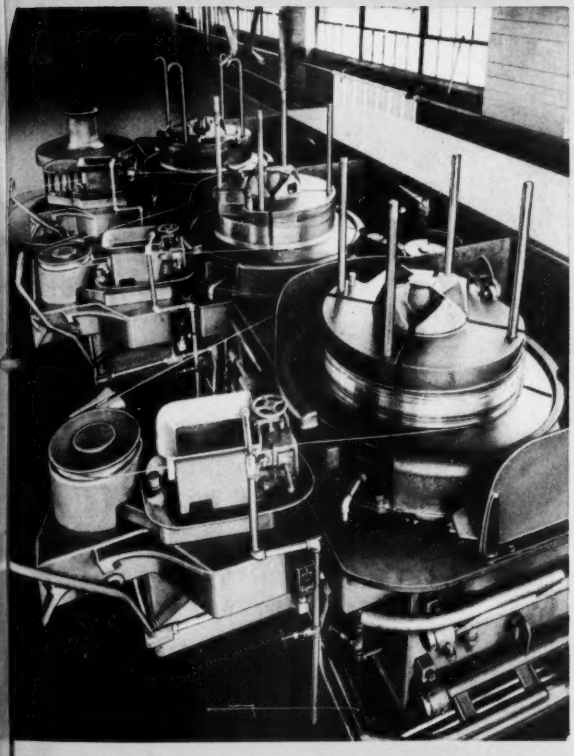

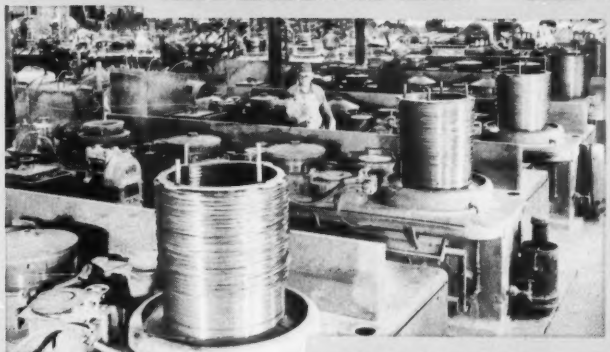

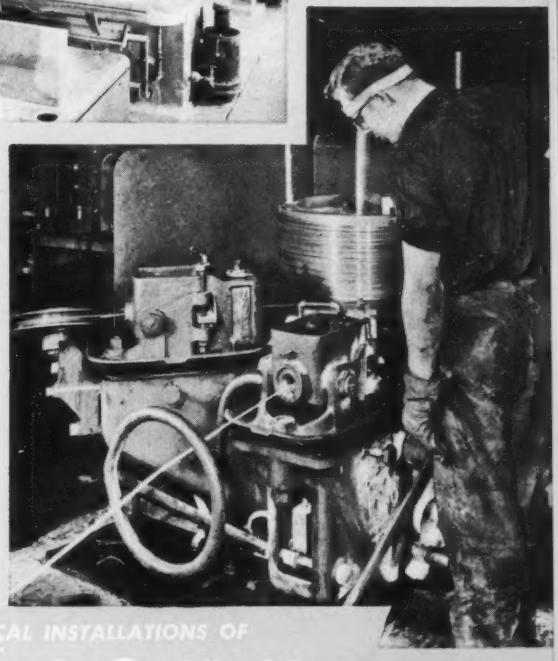

V

TYPICAL INSTALLATIONS OF

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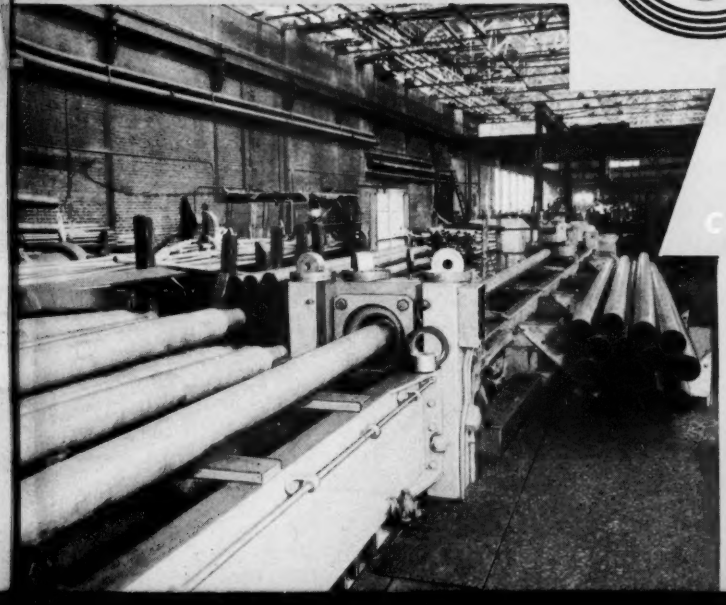
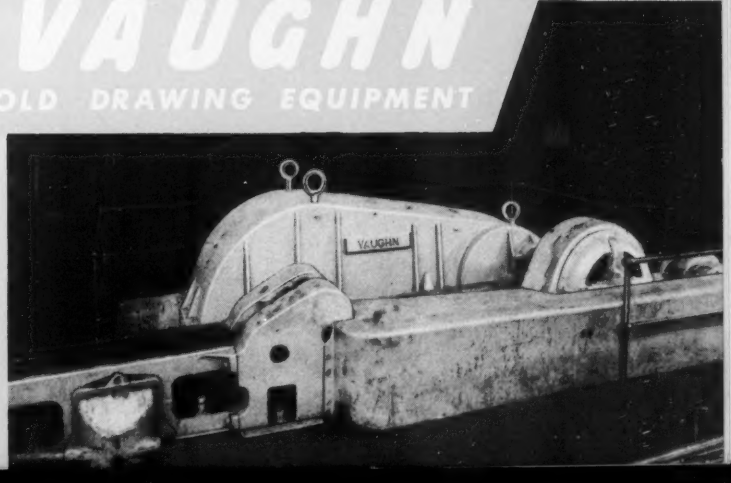
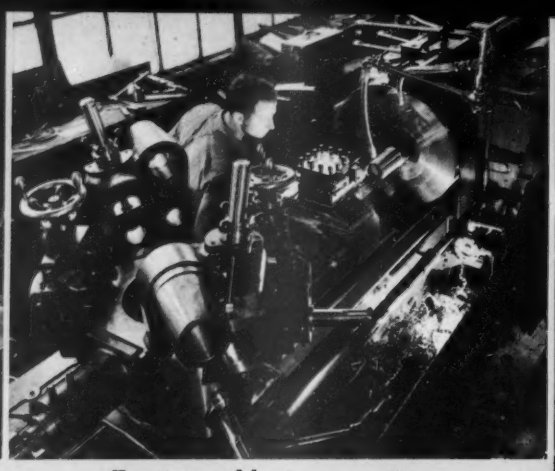
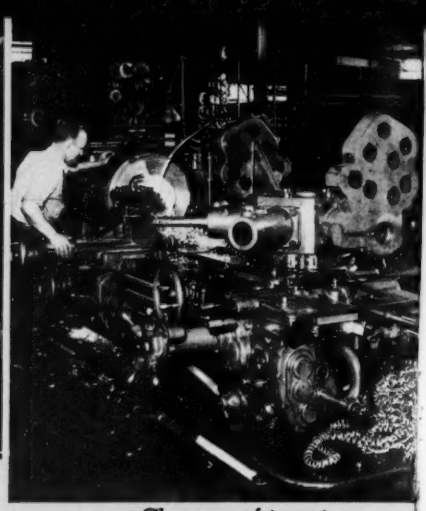




Precision shaft grinding



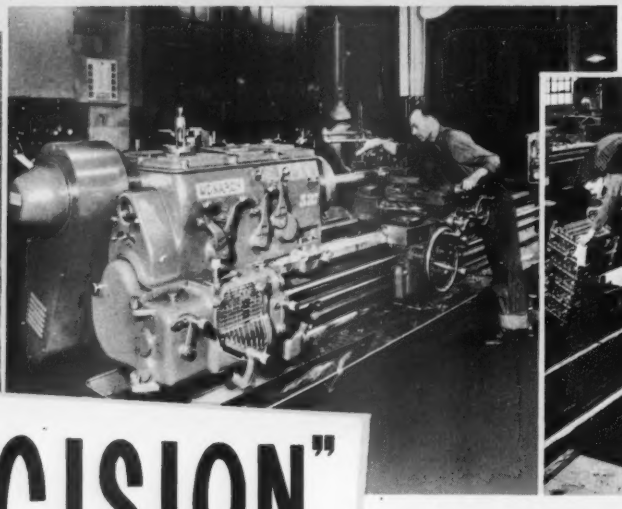
Turning and boring operations



Close-up of turret lathe operation

Small parts inspection

Turning shaft in special lathe



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Stainless Steel Wire In Aircraft

By J. K. Findley,
Metallurgist
Allegheny Ludlum Steel Corp., Dunkirk, N. Y.

Excellent physical characteristics combined with good corrosion resistance have made the use of stainless steel wires, particularly the type commonly known as 18-8, of great value in the construction of modern aircraft. ✦ ✦ ✦ ✦

IN the early development of stainless steel it was only natural that manufacturers should try to produce wire and its fabricated products from both the pearlitic straight chrome steel and the austenitic chrome-nickel steel now generally known as 18-8. At that stage of the development it appeared practical to cold draw only material with relatively low capacity for work hardening; and when very high physical properties were required, pearlitic steels were used which could be heat treated to attain such properties. The pearlitic chrome steels having a relatively low capacity for work hardening were therefore produced with comparative ease in the form of wire, but high physical properties were attained by a final heat treatment and these properties were directly proportional to the carbon content and were not measurably influenced by cold drawing.

✦ ✦ ✦

THIS along with other factors had a definite limiting effect on any extensive development of straight chromium wire. On the other hand it was found that the austenitic chrome-nickel 18-8 type alloy had a tremendous capacity for work hardening; and, even with the equipment available, at that time, extremely high properties could be attained by merely cold drawing. This steel did not respond to heat treatment except such heat treatment as was used for softening or reducing its tensile strength. With the equipment available, however, the physical properties obtained by cold drawing were such that the improvement of cold drawing practice and further investigation of this alloy were indicated.

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AT that time the lack of sturdy machines as well as the lack of knowledge of proper dies, lubricants, and lubricating coatings limited the amount of cold work on 18-8 to about 75% reduction, and this percentage could only be reached on sizes smaller than .075″ diameter. With 75% reduction, the alloy had a tensile strength of approximately 250,000 pounds per square inch and an elongation of 10″ of only ½ of 1%.

J. K. FINDLEY

Born in Butler, Pa., in 1899; educated in the Butler public schools and Rensselaer Polytechnic Institute, Troy, N. Y.; chemist at Jones & Laughlin Steel Corp., Pittsburgh, 1922 to 1924; chemist at Atlas Steel Corp., Dunkirk, N. Y., 1925 to 1929; 1929 to present time—metallurgical department as metallurgist on stainless steel in the same plant, which was subsequently merged with Ludlum Steel Co., and is now Allegheny Ludlum Steel Corp.

Nevertheless, the wire was quite tough. This strength was somewhat short of the strength of the tinned piano wire that went into the construction of the control cords used in the aircraft industry. Improved cold drawing practice, however, gradually made possible tensile strengths of from 300,000 to 345,000 pounds per square inch on wire sizes used in the manufacture of stainless aircraft control cords, so that now the strength of stranded 18-8 cord equals the strength of the best galvanized or tinned steel cord.

✦ ✦ ✦

THE aircraft industry soon was investigating the possibility that this 18-8 stainless wire might have in correcting some of their wire problems. The safe life of control cord was one of the first to be investigated. Corrosion of this cord was not a problem with planes that always flew well inland but any coastal or oversea planes came in contact with salt air corrosion. This involved periodic examination and frequent replacements of tinned or galvanized steel cord. The stainless alloy had one big factor in its favor and that was its infinitely greater resistance to salt air corrosion. Even a slight degree of surface corrosion means a considerable decrease in the life of the wires in a high strength wire rope or cord and even more in a rope or cord which is continually flexed. This 18-8 alloy also has a high fatigue limit, a necessary requisite of material subject to continual flexing.

✦ ✦ ✦

THE magnetic permeability of stainless cord or wire rope is

infinitely lower than that of steel. This is an important factor in the alloy's use in aircraft construction where the cord is in the vicinity of instruments which might be affected by magnetic material. The desire for a non-magnetic stainless control cord was so great a few years ago that considerable experimental work was done to produce such a cord but it was found that the sacrifice in strength was too great to make it practical. It is now possible to limit the permeability on individual wires to a maximum of 2 by raising the nickel content of chrome-nickel alloy to about 12%. This alloy, however, cannot be cold drawn consistently to tensile strengths above 245,000 pounds per square inch, and, consequently, cord or wire rope made of this composition will be somewhat lower in breaking strength than that made from the regular 18-8 analysis.

✦ ✦ ✦

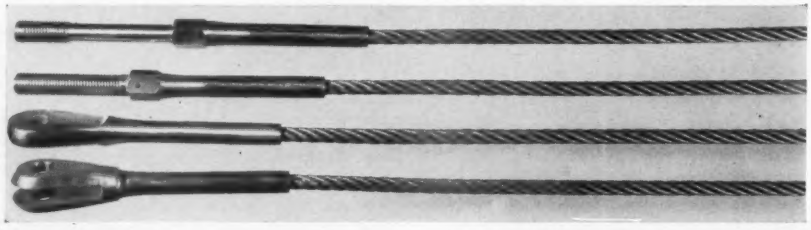
THERE are several other cable applications on aircraft where stainless wire rope is extensively used. Mainly these uses are anchor ropes, mooring pendants, push-pull controls, and hoisting slings. For mooring pendants seaplane manufacturers have specified the molybdenum bearing 18-8 wire due to its increased resistance to salt air conditions. The higher nickel content in this molybdenum bearing 18-8 stainless lowers the tensile strength compared to that of regular 18-8, but the increased corrosion resistance under the conditions encountered has justified the use of the lower tensile material. In the construction of these various wire ropes or cords, the push-pull controls are usually 1 x 19 and the majority of other uses are 7 x 19 construction.

✦ ✦ ✦

THE production of approximately 1,000,000 feet of stainless rope or cord every month for present aircraft production certainly indicates that it has found a field where its worth offsets its initial cost. The specifications to which the stainless wires are made are high and rigid, and our research indicates that possible future improvements in stainless wire rope may eventually permit even higher specifications.

✦ ✦ ✦

AN important use for 18-8 chrome-nickel stainless wire on aircraft, where its corrosion resistance is a negligible factor, is in the stranded high tension magneto ignition cables. For this, dead soft 18-8 wire is used. Its strength of approximately 90,000 pounds per square inch as well as its softness and ductility is an advantage in the construction of the heavily insulated finished cable, yet this annealed type of wire was chosen because of its electrical



Airplane Cable Terminals.

✦ ✦ ✦ ✦ ✦ ✦ ✦

characteristics which produce a better timed and conditioned spark regardless of length of ignition cable.

✦ ✦ ✦

MANY small stainless steel machine screws are used in the numerous navigating aircraft instruments. The free machining modification of 18% chrome 8% nickel alloy with its excellent corrosion resistance, high strength, and above all, non-magnetic properties, has been chosen for this job. Various pins and shafts of the same alloy are used in these instruments for the same reason.

✦ ✦ ✦

HINGES and hinge pins used in the cowling and on various inspection drawers are again made from annealed stainless steel wire because of its non-magnetic properties. Throughout the construction of a plane, particularly in the motor assembly, there are various uses for rather stiff tempered locking pins and cotter pins, made from 18-8 or 18-8 plus molybdenum wire.

✦ ✦ ✦

A RATHER familiar term in aircraft assembly is safety wire, most commonly used to prevent various nuts, turn buckles, and pins from rotating from a set position. Dead soft annealed 18-8 or 18-8 plus molybdenum is again specified because of its non-magnetic qualities, its corrosion resistance and its pliability.

✦ ✦ ✦

WHERE the use of small coil springs is necessary in the assembly of aircraft or the assembly of component parts, stainless spring wire is usually specified. The low magnetic permeability of 18-8 and the practically non-magnetic properties of the higher nickel or 18-8 with molybdenum coupled with their physical characteristics are very favorable to the application of these alloys. There is very little change in strength or stress characteristics in these alloys up to at least 350°F. which makes the material ideal for most thermostatic springs. On some applications, springs have been operated at 700°F. and still maintained high enough elastic properties to justify their service.

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THE wires used in practically all of the above applications are the so-called fine sizes, ranging from a diameter of .005″ to about .100″. The sizes involved in the construction of aircraft control cord usually are in the range of .007″ to .020″ in diameter. Wires used in the construction of mooring pendants are seldom larger than .063″ in diameter.

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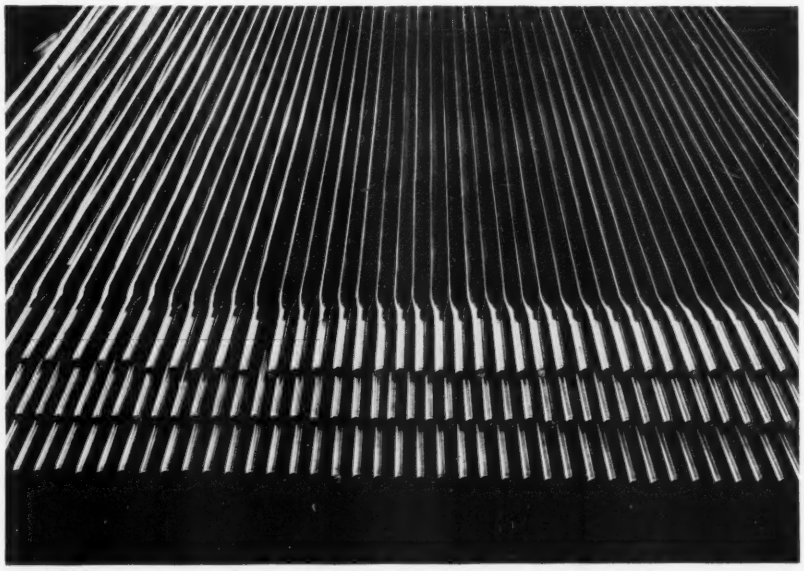
THERE are some very important uses for the larger diameter stainless steel wires in sizes running from approximately 1/8″ diameter into sizes that would be classified as fair bar dimensions.

ONE of these applications is for streamlined aircraft tie rods. The larger land aircraft no longer use external or streamlined tie rods in their construction. Smaller training planes, however, still use them as do seaplanes, particularly in connection with the fastening of floats. These rods are manufactured from round bars 1/8" up to 3/4" diameter.

✦ ✦ ✦

MOLYBDENUM bearing 18-8, that is, Type 317, has been chosen by seaplane manufacturers as best suited to withstand the type of corrosion encountered by this class of aircraft. Several inches on both ends of the rods are rounded and threaded to take the fittings used in fastening them to the ships. The lengths of rods between these round ends are formed to oval sections. As mentioned before, this alloy cannot be worked to so high a strength as regular 18-8, but the physical properties attained are satisfactory. The accompanying photograph shows a number of these highly polished type 317 aircraft tie rods.



Airplane Tie Rods.

✦ ✦ ✦

ANOTHER notable application of stainless rod in the aircraft field is for the fittings which fasten together the wire rope or connect the wire rope to movable or stationary portions of the ship. The rods used range from $\frac{3}{16}$" diameter wire up to fairly large bar dimensions. One end is made in the form of a sleeve into which the cable end is inserted. The sleeve is then cold swaged in such a way as to squeeze metal down into the valleys of the wire rope, thus perfectly locking the cable into the fitting. This is accomplished with negligible damage to the wires of the cable, leaving unimpaired their breaking strength. The other end of the fitting is made in several shapes, the most common of which are shown in the accompanying photograph. The designations given these fittings as shown in the photograph are from top to bottom Class D, Class A, Class B, and Class C. Several advantages are attained by using chrome nickel stainless steel in the manufacture of these parts. No concern need be felt as to possible corrosion between the cable and the sleeve; the alloy is non-magnetic and therefore does not affect compasses in the vicinity of the fittings made from this stainless; the strength of the alloy is sufficiently high so that fittings need not be bulky in order to have strength equal to or greater than the cables which they hold. A free machining variety of 18-8 has successfully met these requirements for some time and many hundreds of thousands of these alloyed fittings are in use on all types of old and new aircraft.

✦ ✦ ✦

THIS covers fairly well the major uses of stainless wire or rod as applied to aircraft construction. In glancing over these applications one is led to believe that the commonly termed 18-8 alloy or its modifications is the only corrosion resisting steel in wire or rod form that is used in such construction and except for a few terminals or fittings made from Type 410 low carbon 12-14% chrome steel, or Type 431 containing 14-18% chrome and 2% maximum nickel, this is true. The reason for its selection is justified when one compares the properties desired with the properties obtainable on various alloys.

✦ ✦ ✦

IT might be well to give the analysis the writer has in mind for this Type 302 or Type 304, 18-8 alloy used in airplane construction. The range in mind is: C .06-.12%, Mn 2% max., Si .60% max., Cr 17-20%, and Ni 7-12%. Recently some specifications have limited the carbon to .07% max., manganese to .70% max., and the chrome and nickel to 18% and 8% minimums, respectively. The analysis for 18-8 with molybdenum, Type 316 or 317, used for rope or spring wire is C .10% max., Mn 2% max., Cr .17% min., Ni 14% max., and Mo 2% min., while for tie rods the analysis is C .08 max., Mn. 2% max., Ni 14% max., Cr 18% min., and Mo from 3-4%. The free machining 18-8 Type 303 contains C .10% max., Mn 1.20% max., Cr 18% min., Ni 8% min., and either .12-17% P with .15-.30 Selenium, or .12-.17 P with .10% max. Sulphur.

✦ ✦ ✦

THE above ranges of composition come within the limits specified by the aircraft industry covering material for all previously mentioned applications. Recently specifications have been broader in scope to allow proper selection of analysis for the individual applications.

IN review, we find that 18-8 and its modifications are used for springs, pins, wire rope, cable ends, control cord, terminals, and especially control cord. The properties which favor its use are high tensile strength, good toughness, resistance to salt air corrosion, low magnetic permeability, and fair ductility.

✦ ✦ ✦

IN claiming resistance to salt water or salt air corrosion, it is understood that none of these corrosion resisting alloys is 100% resistant under all conditions. The knowledge of their limitations under certain conditions, coupled with proper precautions in assembly and care of the various parts has practically eliminated the problem of corrosion.

✦ ✦ ✦

MANY difficulties have been encountered in making material stainless steel for the Aircraft Industry what it is today. It is not the author's intention, however, to imply that the ultimate has been reached, for further improvement is still desired; yet it must be admitted that the use of stainless steel wire and rod has been of material benefit to the Aircraft Industry. Research leads us to hope and believe that greater improvement can still be made and greater service can yet be rendered this Industry.

Shall We Defend or Attack?

"THE divided opinion of the country, unless changed, reveals what would be a serious weakness, in event of a declaration of war upon us by either Germany or Japan, or by us upon either or both of those nations. The weakness lies in the public attitude in that it is defensive-minded." So states the booklet, "Shall We Defend or Attack?," recently published by Farrel-Birmingham Company, Inc., machinery manufacturers of Ansonia, Connecticut.

✦ ✦ ✦

THE booklet points out that this attitude in the country is due to a confusion between our historical non-aggression foreign policy and a simple defensive military strategy should actual hostilities occur.

✦ ✦ ✦

THE booklet also examines the logical outcome of both an offensive and defensive strategy of war and declares that the assumption of the simple defensive in war "means almost inevitably a long drawn out war, with increasingly heavy losses before the issue is decided. It means disunity within, reflected in political interference with the disposition and employment of armed forces, and the hazard of serious casualties and losses should such interference force a straddle between offensive and defensive grand strategy. It may result in economic dislocations and political changes of a permanent nature; it may indeed even end in a stalemate, followed by indefinite economic isolation and slow strangulation."

✦ ✦ ✦

"FOR a nation which has already thrown down the gauntlet to hostile powers, for a nation which has no longer a choice between war and neutrality, for a nation to whom war may be imminent according to the designs of others, there must be complete unity. For a democratic people that unity can be generated only through a government policy of complete, continuous and intellectually honest frankness as to the facts, and to an administrative policy of decisive domestic action upon the facts. Only in that way can the people themselves be inspired to heed the vital caution of Mahan, the great exponent of American naval strategy:

✦ ✦ ✦

"'IN the matter of preparation for war, one clear idea should be absorbed first by every one who, recognizing that war is a possibility, desires to see his country ready. That idea is that however defensive in origin or political character a war may be, the assumption of the simple defensive in war is ruin. War, once declared, must be waged offensively, aggressively. The enemy must not be fended off but smitten down'."

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Time, Temperature, and Size In The Heating of Steel Wire

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The purpose of this paper is to outline the elements bearing on the absorption of the heat by the wire, which is the fundamental factor which determines not only the success of the operation but also the designs for equipment and the specifications for processing. ✦ ✦

Introduction

CONTINUOUS strand heat treatments of wire are successful, on the whole, because of their background of practical experience. Improvements in practices and products, however, demand constant research into the factors involved. The absorption of heat by the wire is the fundamental factor that determines, not only the success of the operation, but also the design of equipment and the specifications for processing. The literature contains no pertinent references, and heat treating data from batch-type experience may be very misleading. The purpose of this paper, therefore, is to outline the elements bearing on the problem and provide some data on the absorption of heat and the reaction of steel wire to heat which will agree with commercial practice.

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Scope of the Investigation

THE field for research on such a topic as this is tremendous. The one factor of greatest importance is probably the mass (or size) effect on the time required to accomplish a heat treatment. Accordingly, investigation of this was planned first. However, in the course of the work, many other elements were encountered, most of which required study to ascertain their importance. These elements may be broadly summarized in groups such as type of equipment, type of process, temperature, condition of the steel, and finally, subject to any or all of the foregoing, the mass influence.

SAMPLES of commercial round wire have been used throughout the investigation. Sizes ranged from ½″ to 1/16″ in diameter, and various process conditions were included. In the selection of samples, several different heats of steel were utilized, all of them in the medium carbon range. Two basic types of equipment, electric muffle and molten lead heating furnaces, were used in the experimental treatments, and the treatments simulated as closely as possible two types of mill processes, oil tempering and patenting.

RODMAN R. TATNALL

Born in New Rochelle, N. Y., in 1906. Educated at Worcester Polytechnic Institute. First employment one year in Development Dept. of Waltham Watch Co. In 1928, joined Wickwire Spencer Steel Co. in spring production dept. In 1930, was promoted to position of Metallurgical Engineer, and since then has been in charge of experiment and research on spring and spring materials. Member of Wire Association and American Society for Metals.

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Theory of Heat Transfer

WHILE it is intended to keep this report on the practical side, some mention of theoretical heat transfer may be made for reference purposes. Physicists describe three modes of heat transfer — conduction, convection, and radiation, and set up the following laws which govern the action of each.

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TRANSFER of heat by conduction follows **Fourier's** law,

$$H = \frac{A\,(t_1 - t_2)\,T}{d}$$

in which H = quantity of heat,
K = constant, called thermal conductivity,
A = the area thru which the heat passes,
t_1 = the temperature of one point, °F.,
t_2 = the temperature of another point,
d = the distance between the two points,
and T = the time that the heat flows.

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THIS law means that the time required for a given quantity of heat to flow from one point to another is proportional to the distance between them, and inversely proportional to the temperature difference of the two points and the area involved in the heat transfer.

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FOR convection, the law is

$$H = A\,(k' + qk''c)\,(t_1 - t_2)$$

which states that a gas of temperature t_1 (°F.) and of density q passing over an area A with a

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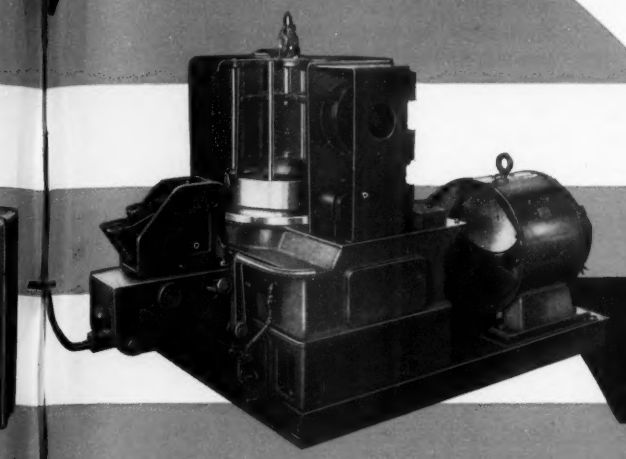

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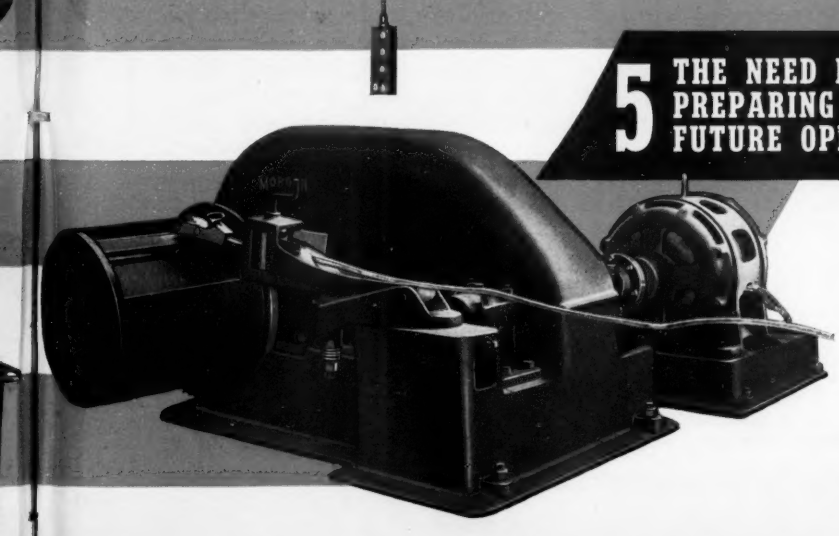

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velocity c transmits a quantity of heat H to that area. k′ and k″ represent respectively heat transmission by diffusion and by turbulence, and vary with the temperature and the composition of the gas.

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IN radiant heating, the physical law is somewhat different. The commonly accepted **Stefan-Boltzman** law is

$$H = Akt\left(\frac{T_1^4}{100} - \frac{T_2^4}{100}\right)$$

in which H is the quantity of heat radiated in time t to an area A having temperature T_2 from a surrounding envelope having a temperature T_1. These temperature values are measured in degrees absolute (degrees F. + 459.6). The value of k varies depending on the approach of the area receiving heat to the physically perfect "black body," that is, its approach to absorption of 100% of the heat energy striking it. This law means that the time required for a given amount of heat to be transferred by radiation varies inversely as the area receiving heat and the difference of the fourth power of the absolute temperatures.

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FROM these formulas, an interesting theoretical comparison may be made between conduction and radiation, considering identical samples subjected to each, and assuming the same quantity of heat absorbed by each. With 1500° and 50° representing respectively furnace and room temperatures, unit area of such a sample is capable of transmitting through unit distance about 43,500 Btu per hour by conduction. The same area under radiation can absorb about 23,750 Btu per hour, even considering it as a perfect "black body." The time, therefore, for the absorption of a given quantity of heat by radiation, under the most advantageous conditions, will still be, theoretically, nearly 2 times as long as the time required for the same quantity by conduction.

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IT is well to consider at this point the manner in which an object absorbs heat when under the influence of some higher temperature. The heating medium acts to increase the temperature of the surface of the object. This increase in temperature then causes heat to flow to the cooler interior. Increase of temperature of the body as a whole to that of the heating medium depends on equalization of temperature throughout, which takes place only by conduction within the object.

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Technique of Investigation

THE furnace equipment used in the laboratory for these investigations consisted of a **Hoskins** 110-volt electric resistance furnace with standard refractory lining and rising door, and an electrically heated lead pot. Temperature capacities were 1800 - 1900° in both cases, and heat capacity was large enough so that no measurable drop in temperature occurred when any of the samples were introduced. With each of these furnaces, a minimum length of six inches could be treated. Samples were provided about twice this length for ease of handling and to allow numbering for identification. Nearly all the samples were treated after a straighten-and-cut operation, as it was felt that straightening would not affect the samples materially, if at all.

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IN the case of the **Hoskins** furnace, a thermocouple hole in the door allowed samples to be inserted into the center of the chamber, and a rest was provided at the back. In this manner samples were supported horizontally at each end, and the center of the treated length was exposed to heat from all directions. Samples could also be laid on the hearth of the furnace. With the lead pot, samples were simply immersed vertically in the molten lead through a charcoal cover. Thermocouples measured the temperature and suitable controls were provided to hold constant the values desired for any series.

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TWO types of treatment were given, oil quenching and air quenching. The oil quenching bath was located between the two furnaces so that there was a minimum of time lag in the quenching operation. All oil quenched samples were agitated slowly in the bath and were later drawn in lead at temperatures which gave approximately normal physical properties. In the case of air quenching the samples withdrawn from the furnace were moved slowly through still air until they had cooled to 700 - 800° and were then laid on a refractory slab to cool to room temperature for testing.

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IN order to establish the relation of time to the various factors studied, a series of samples of sufficient number so that some were obviously underheated and some undoubtedly heated longer than necessary were put through a treatment one by one. Each sample was withdrawn from the furnace after a pre-determined length of time, and quenched. The effect of such treatment was then measured on each sample, and the entire series correlated. From 10 to 20 pieces were used in each series, depending on the nature of the treatment, one at each prescribed time. While more accurate results would undoubtedly be obtained from the average of several pieces treated at each time, it was felt that sufficient accuracy could be obtained through the method of correlating the series, which will be explained a little later.

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IN order to establish the time relation it was necessary to adopt a measure of the effect of the treatment. Several methods are available in the average laboratory, for example, hardness or microstructure. However, hardness tests were not satisfactory because of the necessity of measuring the progression of the treatment by means of hardness tests at various depths in the wire. It was also felt that any attempts to follow changes in structure with microscopic examination would be misleading and cumbersome, even in the hands of the most experienced observer. Trial runs indicated that some progress of a hardening treatment could be observed, but the determination of

the end-point of full hardening was too difficult to be practical. Another property which indicates the progression of treatment is tensile strength, and in this instance it serves as an excellent measure because, in the last analysis, it averages the properties of the entire section in each piece equally well throughout the series. Reduction in area after the tensile fracture showed itself a reliable measure for some purposes. Hence, these tests were carried out on the treated samples and the test results correlated with the time of treatment. When breaking the samples, one-half to one inch in the center of the treated length was free between the jaws of the testing machine, the balance of this length being gripped by the jaws. Thus the portion on which a tensile reading was obtained was a portion that received its heat effect through its surface only, without any complication arising from heat absorbed through the ends, such as might occur with short samples.

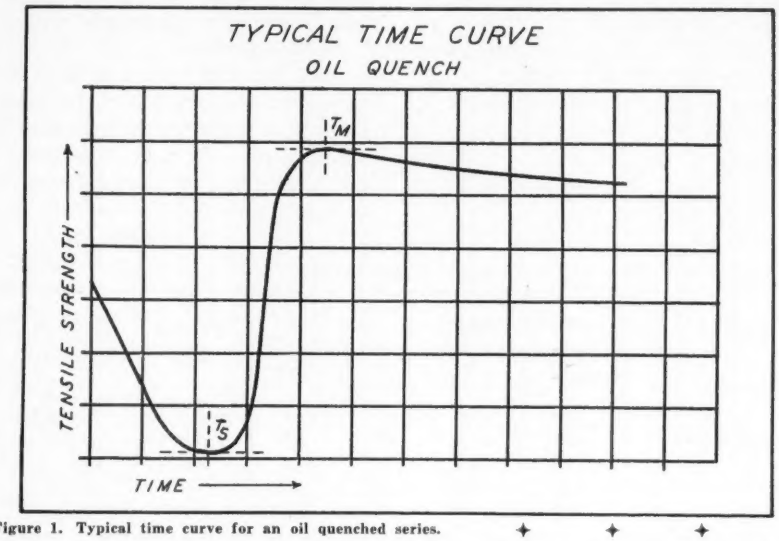

Figure 1. Typical time curve for an oil quenched series.

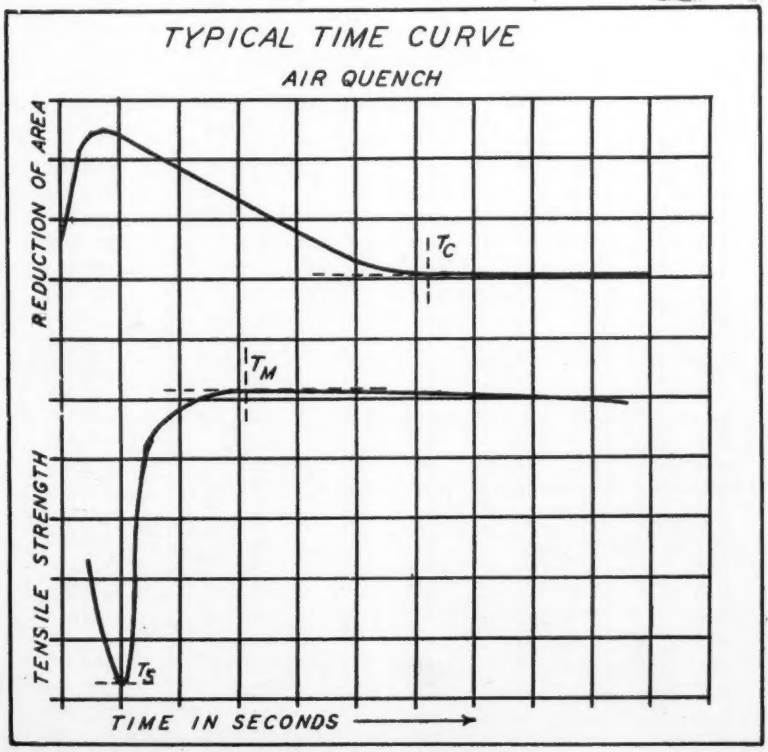

Figure 2. Typical time curves for an air quenched series.

THE tensile test results can best yield information regarding time by plotting tensile strength and reduction in area values against the nominal time of treatment. Typical forms of the graphs obtained are shown in Figures 1 and 2, for oil quenching and air quenching respectively. It will be noted in Figure 1 that no curve of reduction in area has been plotted. Trial in a number of different series showed that this property did not have any real significance in the case of oil quenched samples, as it only repeated the story told by the tensile values. This curve shows that chronologically, the first effect of heat is a softening. This gives way to a rather abrupt hardening which holds for the balance of the time involved. As a measure of a complete treatment, the attainment of this hardness or high tensile strength follows as an index of complete response. The time value at the point where maximum tensile is obtained, shown by the point T_m on the graph, is taken as the index for the series. The point of greatest softening effect, T_s on the graph, is also an indication of the penetration of heat but because of the complications of structure existing at this point in the treatment, it cannot be a reliable measure. The falling off of tensile after the maximum is reached may be attributed very largely to grain growth.

IN Figure 2, values of reduction in area are plotted as well as tensile strength results. It will be shown in more detail later that reduction in area values are an aid in determining the proper progression of the process. In the case of air quenching, it is more difficult to select a critical value from the time curve as a measure of a complete process, the more so because the patenting operation may be carried out with different purposes for different grades of

wire. There is in this graph the development of a maximum tensile strength after a softening effect, but it is doubtful if this furnishes a reliable index. It will be noted that the reduction in area graph reaches a constant value, and this phenomenon is, for the purposes of this paper, at least, the criterion of a complete process of this type. The time required for this to occur, marked T_c, is the time value taken for the series.

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THIS discussion of these two typical curves shows the manner in which the time element is measured, values so determined in turn being used to compare various sets of samples to establish the effect of the several factors previously mentioned. It is to be noted that such values represent the minimum times in which the processes can be completed under the particular conditions existing in the experimental work.

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IT is necessary that some discussion be given to the timing of samples in the furnace. The time prescribed for the treatment of various samples was established after considerable cut-and-try experimenting. As the work progressed new series were readily set up from the experience. Time increments in the various series varied from 30 seconds for coarse sizes muffle heated to ½ second for fine sizes lead heated. This means that if the first sample of a series was immersed in lead for 2 seconds, the next was immersed for 2½ seconds, the next 3, and so on. If one sample was heated in the muffle for 30 seconds, the next might be heated for 60 seconds, and the next for 90, and so on. This procedure raises the question of timing, especially with such short intervals as were required in lead heating. Timing was measured by the observation of a photographic timing clock which measured seconds by means of a long hand and the divisions of a large dial. The manipulation of samples into and out of the furnaces could be carried out with a single rapid motion on the part of the experimenter. While coordination of movement with the second hand of the timer could not be perfect, any slight lag in getting the sample into the influence of heat was made up by a similar slight lag in withdrawal. It was easily possible to estimate half-seconds on the clock used. Any error in timing that might exist lies in muscular reaction, and with some practice it is felt that this error can be kept within about ¼ second. At the same time, the value of time plotted has been referred to as a nominal time. Rather than treat a number of samples at one given time and average the results (which would not be a strictly true average if the variation is due to error in timing) it was felt that any such errors would be compensated by drawing a smooth curve through the plotted points. As a matter of fact, in several cases in the early series, it was necessary to extend the series and overlapping tests were run which matched previous tests very well.

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Materials Investigated

AS stated previously, the materials studied were all in the medium carbon range in analysis. Since the work necessarily extended over a considerable period of time and the type of samples required became apparent only as it progressed, it was not possible to obtain all samples from a single heat of steel. In fact, the necessity of using a variety of steels

TABLE I
Steels Investigated

Steel Symbol	Analysis					Sample Size	Type of Grain
	C	Mn	S	P	Si		
A	.57	.83	.032	.014	.13	Table II	Coarse
B	.65	.82	.029	.020	.17	Table II	Fine
C	.72	.76	.038	.012	.15	.154″	Coarse
D	.61	.77	.028	.014	.18	.148″	Coarse
E	.61	.72	.027	.016	.18	.500″	Coarse

TABLE II
Physical Properties of Samples

Sample Symbol	Size	Patenting Point	% Reduction Cold Work	Tensile Strength As Drawn
A-1	.342″	.375″	16.5	146,500
A-2	.312″	.375″	30.0	155,000
A-3	.275″	.375″	46.0	169,000
A-4	.250″	.375″	55.5	175,500
A-5	.207″	.250″	31.2	158,000
A-6	.187″	.250″	44.0	170,000
A-7	.165″	.250″	56.2	188,000
A-8	.135″	.250″	70.8	201,000
A-9	.105″	.135″	39.2	176,000
A-10	.085″	.135″	60.2	193,000
A-11	.062″	.135″	78.8	215,000
B-1	.250″	.281″	20.5	167,000
B-5	.148″	.281″	72.1	210,000
C-1	.154″	.154″	0	140,000
C-2	.154″	.207″	47.3	170,000
D-1	.148″	.148″	0	136,000
D-2	.148″	.172″	25.5	147,300
D-3	.148″	.192″	40.5	155,800
D-4	.148″	.216″	53.0	167,400
D-5	.148″	.244″	62.8	180,600
D-6	.148″	.275″	71.0	189,800
D-7	.148″	.312″	77.5	206,600
D-8	.148″	.344″	81.0	200,800
D-9	.148″	.375″	84.4	217,000

offered an opportunity to examine the effect of variations in analysis and other factors. Table I lists the several steels employed, with their analysis and other characteristics.

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STEEL A was a coarse grained steel and was used primarily for the study of mass effect. Samples were prepared by drawing one coil of rods from ⅜" to .062" with heat treatments and drafting which provided a conservative process. Samples of Steel B, which was a fine grained steel, were prepared in a similar manner. Steel C was used in one size only, partly because it had considerable difference in analysis compared with the others, and partly because, in securing samples an opportunity offered to obtain a comparison be tween cold worked samples and the same material after patenting. It was also useful for an extensive study of temperature influence. For a thorough exploration of cold work effects, Steel D was used. In this case, one coil of rods was drawn, dropping off a portion at each draft. These portions were then patented and drawn, by the same sizes, to finish at .148". Steel E was used only in the ½" size, the purpose of this series being to provide a check on the mass effect found from other tests on smaller samples. Various lots from these steels were used in other lines of investigation as well, which will be described later. Pertinent information concerning these samples will be found in Table II.

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SAMPLES of Steel D were used in a special form for a study of the effect of structure on the time required for heating, for which purpose two heat treatments were given in the laboratory furnace prior to the experimental runs. A number of pieces of sample D-1 were heated in the muffle furnace for 15 minutes at 1500° and then allowed to cool with the furnace to room temperature. The purpose of this was to obtain a structure of free ferrite and coarse pearlite. In addition, pieces of sample D-8, chosen because this sample had received considerable cold work, were treated in the muffle furnace for a period of 12 hours at 1280 - 1290°. The attempt in this case was to obtain a spheroidized structure. The D-1 sample as obtained from the mill provided a structure of fine pearlite as produced by commercial patenting.

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Results Obtained

THE results obtained from the treatment and test of these various samples have been plotted to give a time curve for each series. Over 1750 samples were treated and tested, and the time curves number over 100. Some of these curves illustrating particular points are given in this paper, but it is obviously not feasible to present them all. The balance of the results are shown in tabular form, the results given being the time values determined according to the criteria previously established. From these tables, further comparisons may be readily made by the selection of appropriate series.

TABLE III
Results of Tests on Steel A

Sample Symbol	Time in Seconds Required to Complete Process					
	Muffle Heating					
	1500°		1700°		1900°	
	Oil Quench	Air Quench	Oil Quench	Air Quench	Oil Quench	Air Quench
A-1	204	290	...	...	...	...
A-2	185	430	...	...	...	...
A-3	...	260	...	...	...	...
A-4	...	230	...	...	...	...
A-5	85	260	...	220	...	130
A-6	83	120	55	...	36.5	...
A-9	55	...	...	...	...	...
A-11	23	...	...	...	...	...

	Lead Heating					
	1400°	1500°		1600°	1700°	1800°
	Oil Quench	Oil Quench	Air Quench	Oil Quench	Oil Quench	Oil Quench
A-2	...	67	...	...	...	...
A-3	...	11.5	17	...	...	...
A-4	12	10	...	6.2	5.8	5.0
A-5	...	16	...	...	...	...

TABLE IV
Results of Tests on Steel A, Treated in Hearth Contact

Sample Symbol	Time in Seconds Required to Complete Process
	Oil Quenched — 1500°
A-2	230
A-3	188
A-4	182
A-5	110
A-6	96
A-8	55
A-9	50
A-10	35

THE first and most important comparison is that of radiant and conductive heating. Such a comparison may be quickly made if it can be based on the assumption that muffle heating is very nearly 100% radiant while lead is very nearly 100% conduction. To show that this assumption is valid, we need only to consider the transfer of heat from the furnace wall to the surface of the wire. It is doubtful if convection currents, either in the muffle atmosphere or

in the molten lead, are sufficient to have any appreciable effect. In the muffle, conduction of heat from the furnace walls by the atmosphere is at a tremendously slower rate than radiation of heat from the same walls, and therefore the mode of heating is so overwhelmingly by radiation that the other modes may be neglected entirely. In the lead pot, radiation is nil, and the mode of heating is so nearly entirely by conduction that convection may be ignored.

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WITH this argument in mind, a direct comparison of radiation and conduction may be made from a comparison of results from muffle and lead treatments at the same temperatures on identical samples, such as B-5, C-1, C-2, D-1, and many others. It will be found that in the case of oil quenching radiant heat requires an average of 20 times as long as conduction. In air quenching, the time ratio is rather different, as might be expected, radiant heat taking about 7 times as long as conductive heating. These ratios might be compared with the theoretical ratio mentioned earlier, and indicate that

TABLE V
Results of Tests on Steel B

Treatment Temperature	Time in Seconds Required to Complete Process		
	Muffle Heating		Lead Heating
	Oil Quench	Air Quench	Oil Quench
Sample B-1			
1400°	...	...	11
1500	160	...	7
1600	...	...	6
1700	...	...	4
1800	...	...	5
Sample B-5			
1400°	...	...	4.5
1500	66	145	3.0
1600	...	...	3.0
1700	...	...	2.0
1800	...	...	1.5

TABLE VI
Results of Tests on Steel C
Oil Quenched

Treatment Temperature	Time in Seconds Required to Complete Process			
	C-1, Patented		C-2, Cold Drawn	
	Muffle Heated	Lead Heated	Muffle Heated	Lead Heated
1400°	103	5.0	114	4.5
1500	70	2.5	81	...
1600	56	2.5	59	3.0
1700	44	1.5	47	...
1800	32.5	1.5	35	1.5
1900	29	...	29.5	...

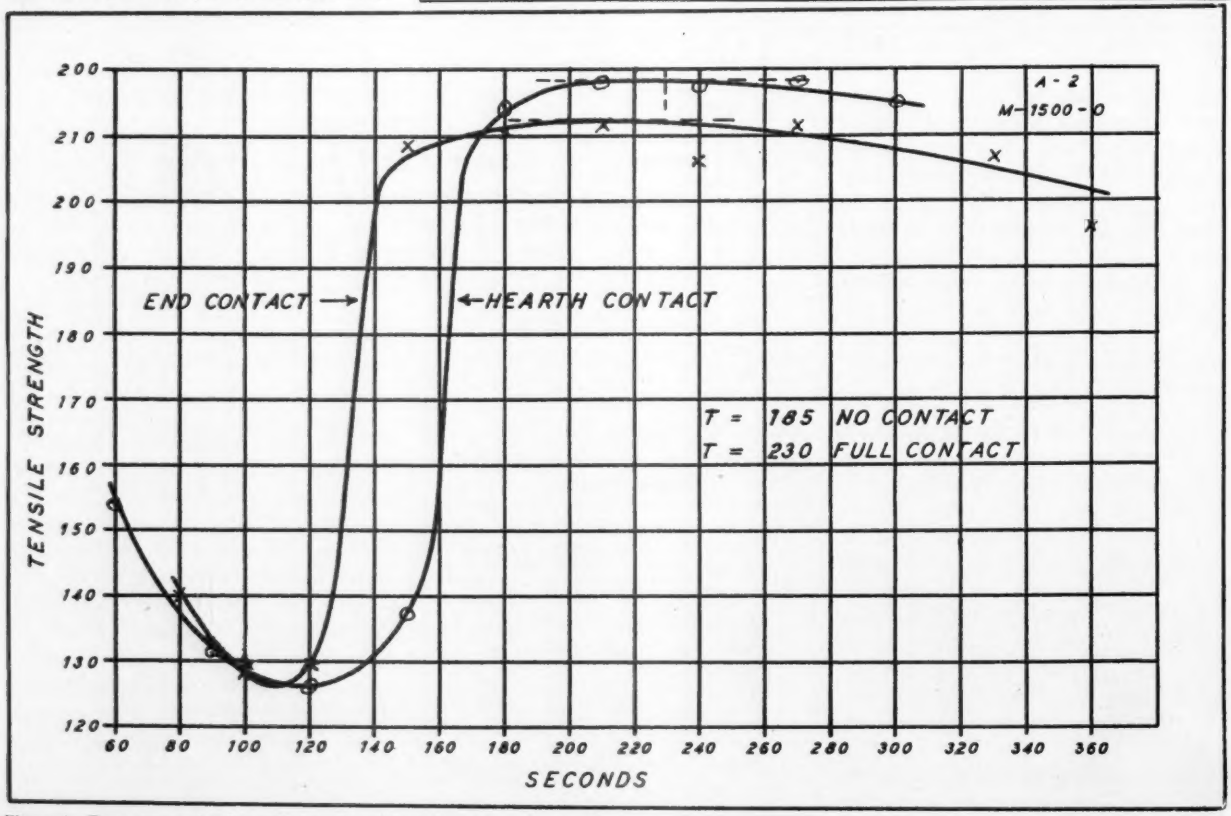

Figure 3. Time curves showing mixed modes of heat transfer.

ordinary cold drawn wire is far from the perfect black body of the radiation theory.

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ANOTHER type of heating was studied more or less by accident when some samples were placed in the muffle furnace in contact with the hearth. The effect on the time is illustrated by Figure 3 which is a graph of two series run on sample A-5, one lying on the hearth of the furnace and the other supported at the ends as previously outlined. The reason that the time for the sample in contact is longer lies in a consideration of the conduction of heat from the hearth to the wire. The quantity of heat required by the wire is very much more in this case than the quantity available in the hearth at and near the line of contact. When the wire is laid on the hearth the latter at once loses heat and turns black. Transfer of heat to the wire by this means slows down markedly and may stop entirely, while radiant heat continues to be absorbed through the top and sides of the wire. Thus the time difference is accounted for in the facts that there is less surface exposed to the radiant heat, and at the same time the heat absorbed by that surface must travel by conduction a much greater distance in the wire. A further comment on this topic will be made later under the discussion of mass influence.

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TO bring out clearly differences in the characteristics of the time curves for different processes, two series of tests are shown in Figures 4a and 4b, the processes being oil quench and air quench respectively on sample D-5. It is to be noted that, aside from the difference in final tensile strength which follows from the nature of the quench, the chief difference between the two curves is an apparent time lag in the reaction of the steel in air quenching, and particularly in the time interval between the softening action of heat and the full completion of the process. The relative

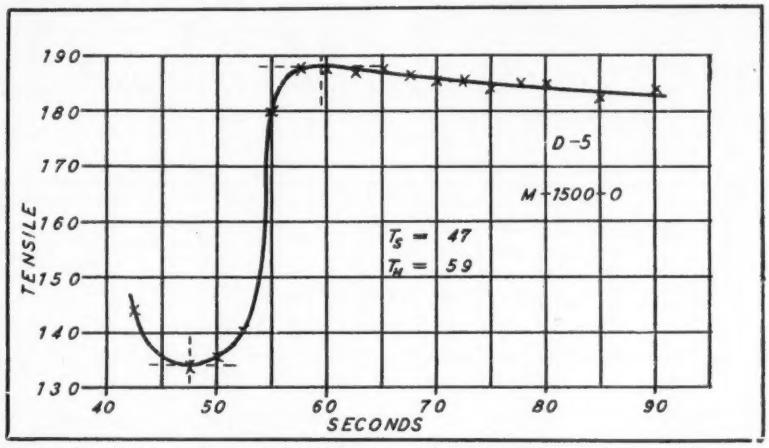

Figure 4a. Sample D-5 oil quenched from muffle.

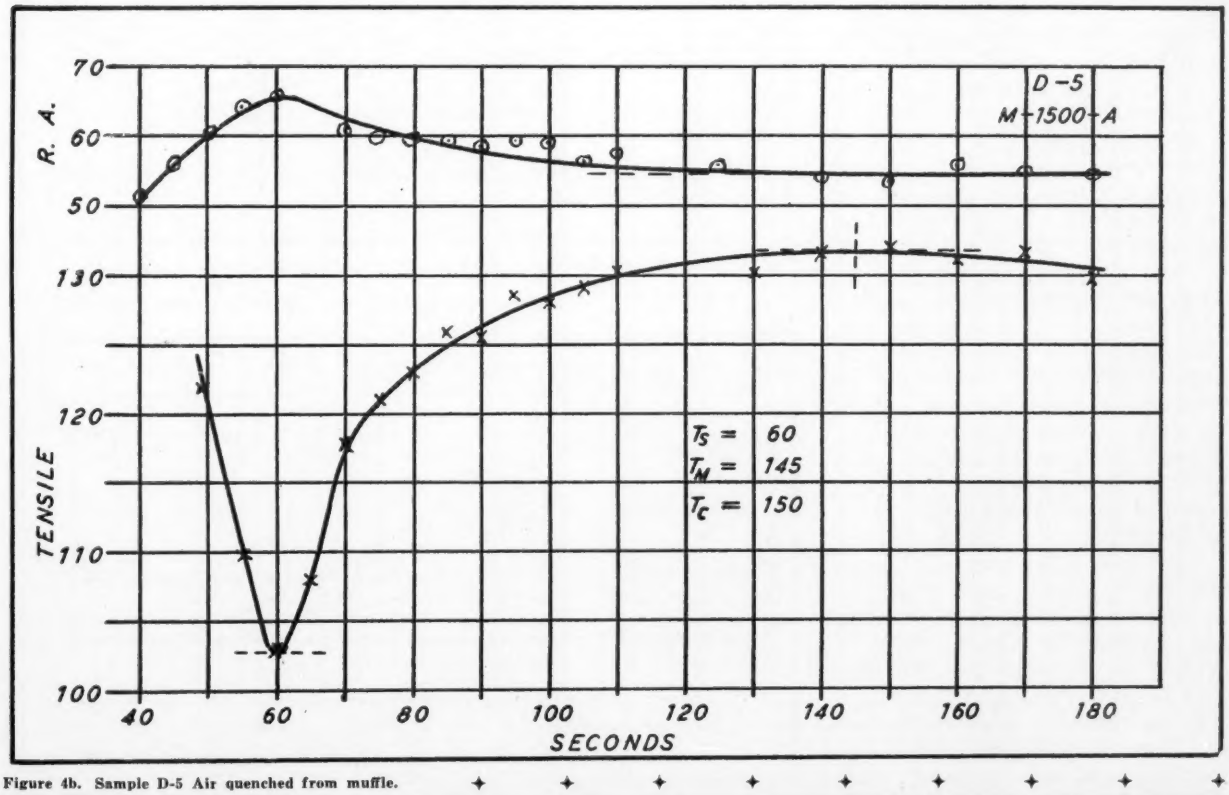

Figure 4b. Sample D-5 Air quenched from muffle.

interval between greatest softening and full hardening is about 12 seconds in oil quenching. With air quenching this relative interval is 90 seconds, and the point of greatest softening occurs in 60 seconds compared with 47 found with oil quenching. The over-all time is then 59 seconds for oil quenching and 150 seconds for air quench. Some explanation of this time lag may be found in the fact that oil quenching constitutes an abrupt abstraction of heat and a sharp limit to the time it can act, while in air quenching a considerable period of time occurs after the sample is taken from the furnace when its temperature remains comparatively high.

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ONE of the most important influences on the rate of heating is the temperature employed. While the effect of temperature might be inferred from the theoretical laws governing the effect of temperature difference on the amount of heat transferred, these laws fail when steel is heated through its critical range due to the absorption of heat at a constant temperature. Further, they take no account of time at temperature for the full accomplishment of the treatment. Consequently, any attempt to match experimental curves with the theoretical formulas is pointless, and such curves are given here only for what value they may contain in themselves. In Figure 5 are curves showing the times required at various temperatures for oil quenching from the muffle samples of C-1 and C-2. The same samples, oil quenched from lead, give the results shown in Figure 6. A composite graph is given in Figure 7 which shows the results of several tests under various conditions. From the type of curves obtained in all these cases, it is apparent that time approaches infinity as the temperature nears the lower critical, and time approaches zero as temperature becomes increasingly high. This is entirely reasonable and in line with theory, and it seems that this type of function holds regardless of heating medium, quenching medium, or size, although the

TABLE VII
Results of Tests on Steel D

Sample Symbol	Time in Seconds Required to Complete Process						
	Muffle Heating			Lead Heating			
	1500°		1800°	1500°		1800°	
	Oil Quench	Air Quench	Air Quench	Oil Quench	Air Quench	Oil Quench	Air Quench
D-1	58	145	110	3.4	5.0	2.0	4.5
D-2	61	...	85	...	...	...	...
D-3	60	...	85	4.2	4.5	...	...
D-4	60	...	65	...	...	...	...
D-5	59	150	70	3.2	3.5	1.7	4.5
D-6	63	...	60	...	...	...	...
D-7	71	...	75	4.0	3.0	...	...
D-8	62	...	75	...	...	...	...
D-9	61	130	75	3.8	3.0	1.6	3.5

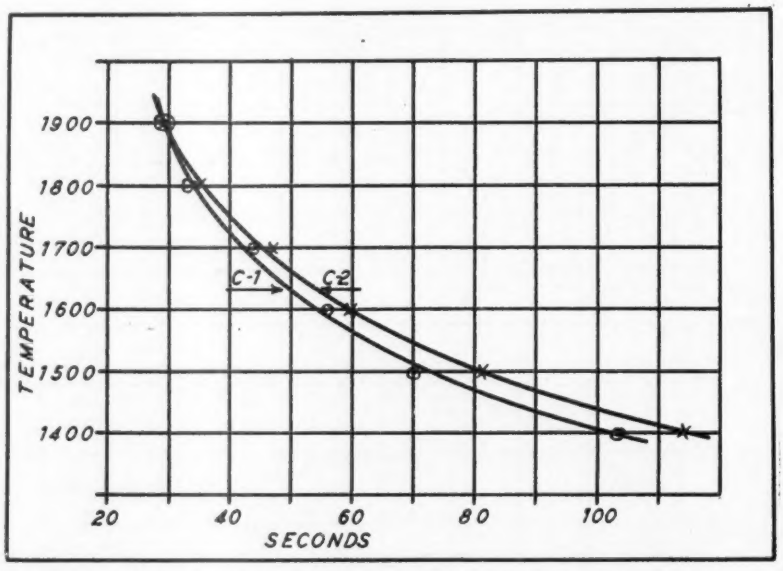


Figure 5. Effect of temperature on samples C-1 and C-2. Muffle heated and oil quenched. ✦

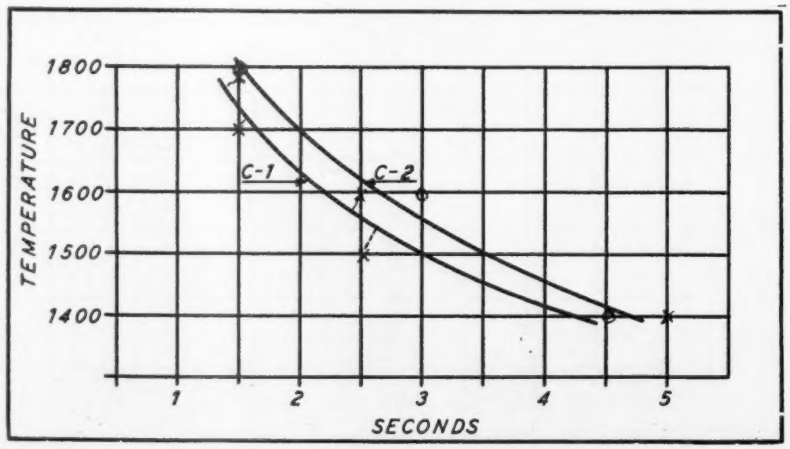


Figure 6. Effect of temperature on samples C-1 and C-2. Lead heated and oil quenched. ✦

time scale is different in different cases. It is just this time scale that is impossible to correlate with the theoretical formulas.

✦ ✦ ✦

A SECOND important effect of temperature is the influence it exerts in the patenting treatment. Figures 8, 9, and 10 show the time curves resulting from air quenching sample A-5 from the muffle furnace at temperatures of 1500°, 1700°, and 1900° respectively. The chief characteristics of Figure 8 are the slow and gradual approach to a maximum tensile and the slow approach of the reduction in area curve to a constant value. It might be noted that this reduction in area value is about 52%. In Figure 9, a maximum tensile is reached more sharply and some falling off is observed. The reduction in area drops more abruptly and becomes constant in value at about 44%. Figure 10 shows the effect of 1900° with a sharp maximum tensile and an even more abrupt drop in reduction in area and more abrupt approach to a constant value which is about 36%. It is worth noting that the tensile strength attained as a maximum is practically the same in each case, while the reduction in area values are very different. The previous statement that a constant reduction in area value should be the criterion of completeness can now be supported with a consideration of these three figures. It should be remembered that maximum tensile strength is dependent on rate of cooling, while reduction in area, although broadly speaking is also dependent on rate of cooling, is actually in this instance dependent on grain size. The falling off of tensile and the drop in reduction is the result of grain growth which is a function of both temperature and time. The maximum tensile shown by these graphs is a compromise between the effects of the rate of cooling and grain growth, and actually represents approximately the finest grain that might be produced by the treatment. On the other hand, when the reduction in area becomes constant, the steel has practically reached a state of temperature equilibrium as far as grain size is concerned. Since patenting is a treatment primarily for grain size and structure, this criterion should naturally follow for completeness of treatment. Figure II gives a summary of time values determ-

TABLE VIII
Comparison of Several Steels
Oil Quenched

Steel Symbol	Size	Time in Seconds Required to Complete Process	
		Muffle Heated	Lead Heated
A	.135"	55	...
B	.148	66	3.0
C	.154	75	2.5
D	.148	62	3.7

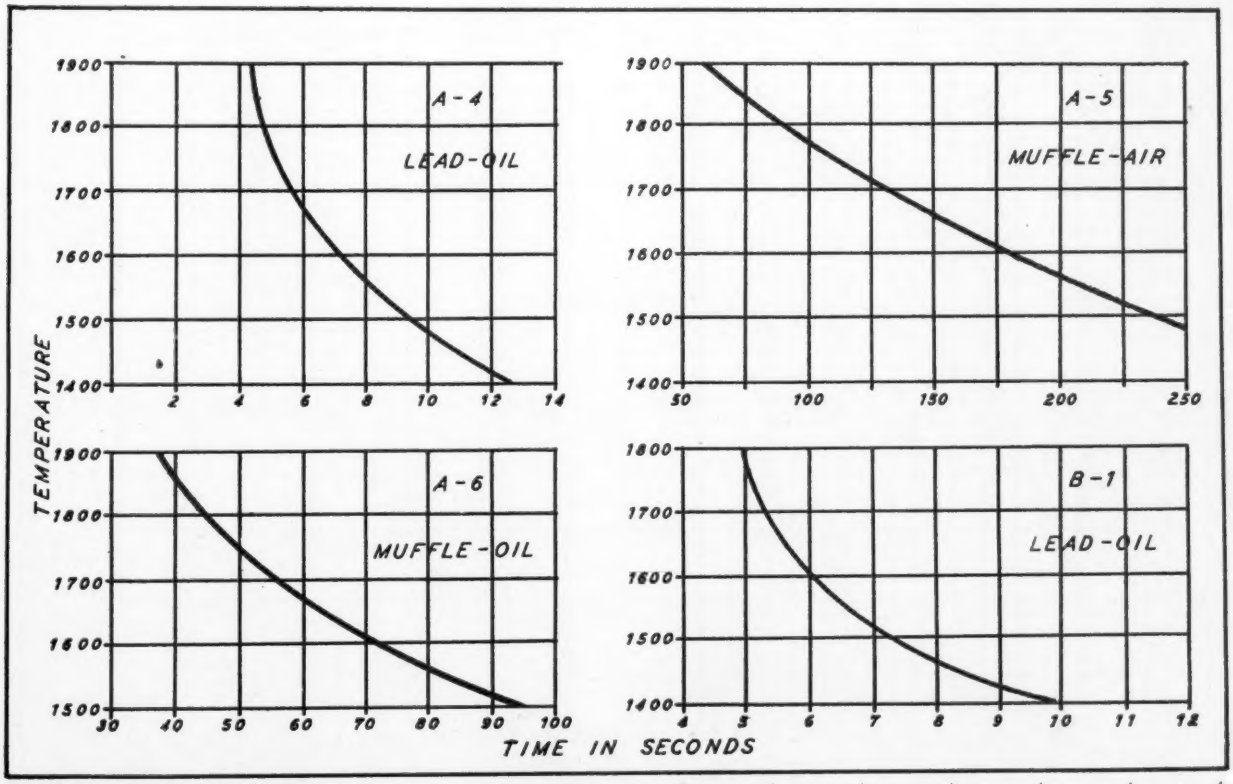


Figure 7. Effect of temperature on various samples.

ined by the attainment of maximum tensile, an arbitrary 50% reduction in area, and the attainment of a constant value of reduction in area, in these three curves. It is apparent that the first two methods of determining time result in values that are considerably less than that shown by the third. Regardless of its position in time, the selection of any arbitrary point on the graph prior to the attainment of constant reduction in area sets up a criterion which is in reality a time at which the steel is still in transition, at least in grain size. An added point is the fact that the curve of Figure 8 does not reach 50% at all in its reduction of area values, and yet such a treatment may be perfectly satisfactory in its sphere. The significant point in this discussion is that a patenting treatment should not be considered complete in any time less than that required for the steel to attain reasonable temperature equilibrium, which is evidenced by a constant value of reduction in area on the time graph.

✦ ✦ ✦

AN influence which might be expected to be important in the treatment of process wire is the amount of cold work in the material being treated. Investigation carried out with steel D indicates, however, that cold work does not have any influence in the oil quenching process. It does have an appreciable effect in patenting. Results of tests are given in Table VII and are further summarized in Figure 12 for oil quench and Figure 13 for air quench. It will be seen that the time values shown in Figure 12 are somewhat variable but show no definite trend up or down. In Figure 13, there is a definite lowering of time as cold work increases.

✦ ✦ ✦

IT may have been noted that sample D-7 in Figure 12 (77.5% reduction) shows a time rather out of line with the others in the series muffle treated. The reason for this lies in the fact that this sample came through the wire drawing operation with a brightly burnished surface due to misapplication of lubricant. This surface then had a different reflectivity factor than the others. As a matter of fact, the reflectivity of the patented (and pickled) sample differed from that of samples in the cold drawn state. This factor of reflectivity has been referred to already as the "black body" characteristic. To bring out the effect this factor may have, Figure 14 is a photograph of the surface of selected samples. 'A' is a piece of sample D-1 which has a pickled surface after patenting, and this series showed a time value of 58 seconds in oil quenching from the muffle at 1500°. 'B' is a piece of sample D-6 which had a typical gray soap and lime coating and gave a time value of 63 in the same treatment. 'C' is a piece of sample D-7 having a bright smooth surface. The time

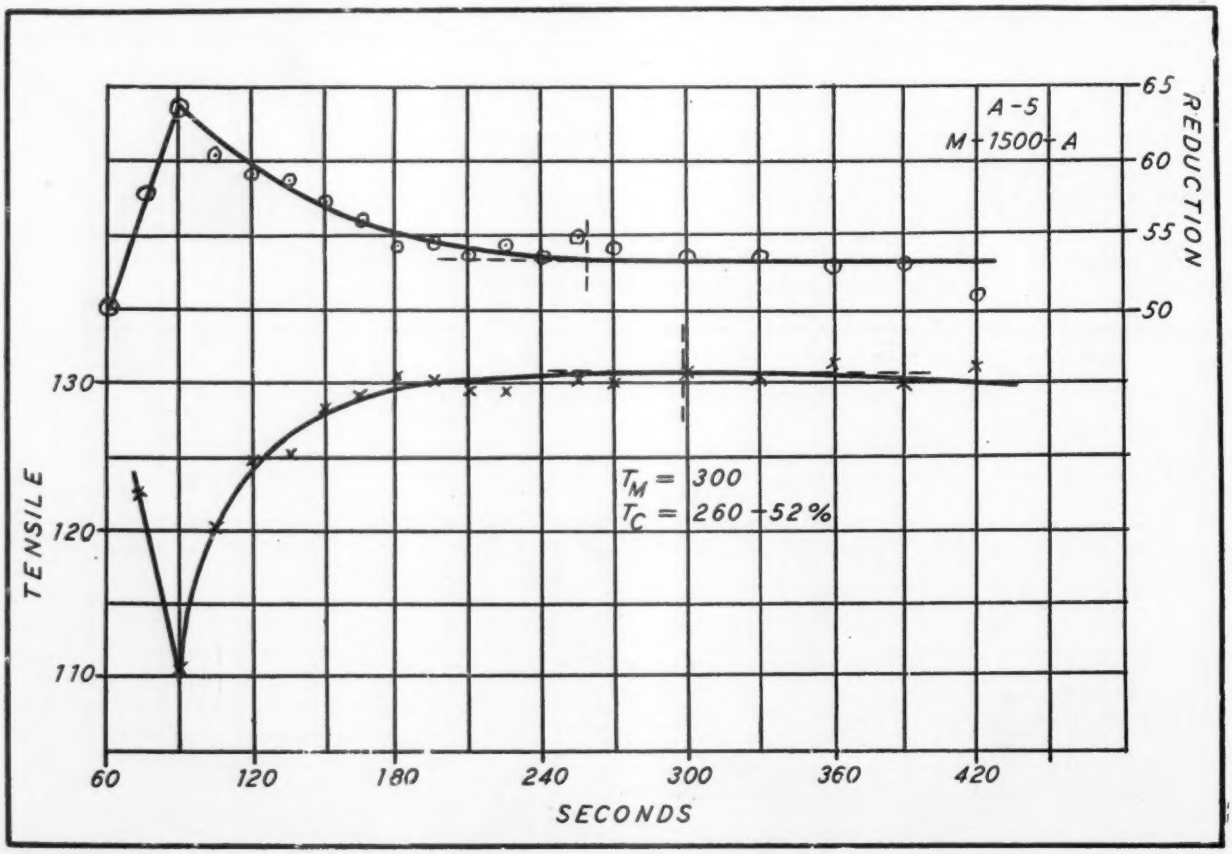


Figure 8. Time curve—Sample A-5, air quenched from 1500°. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

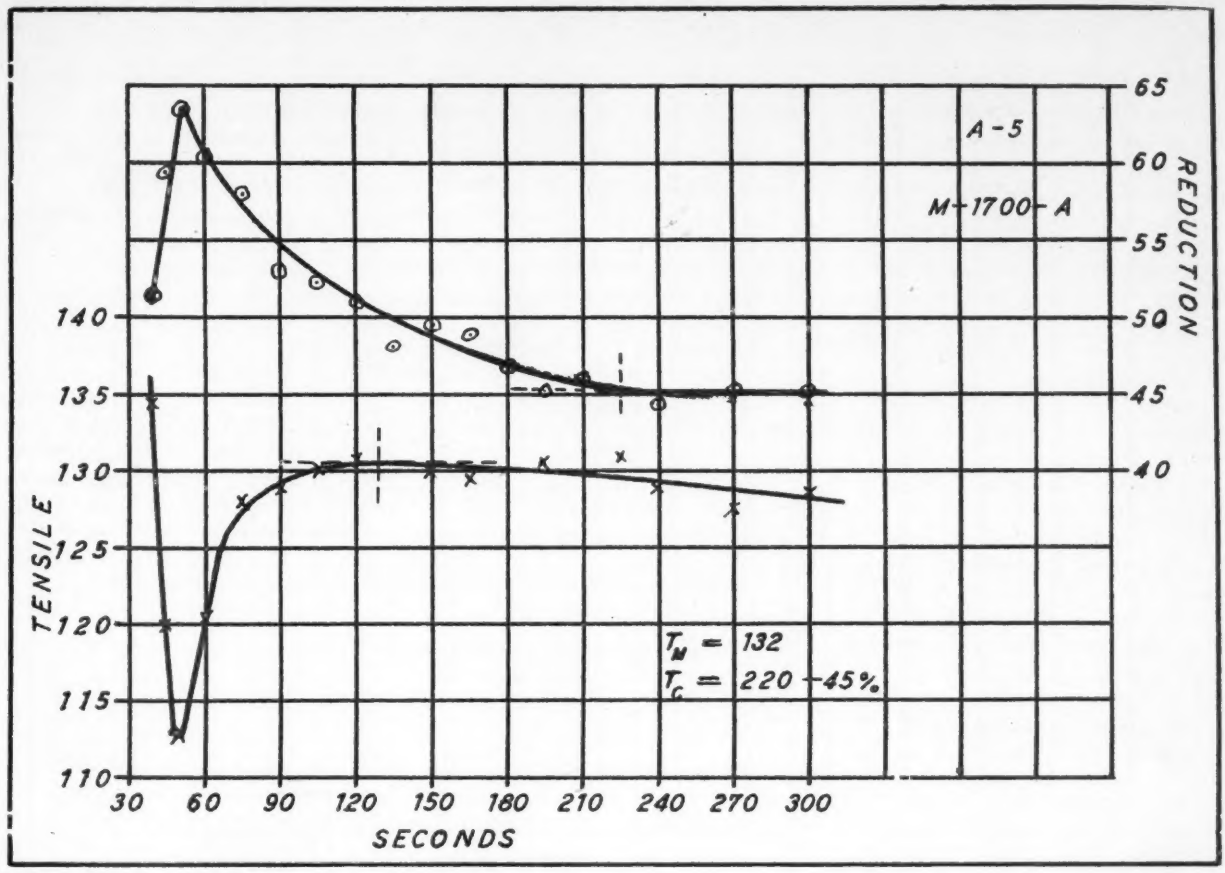


Figure 9. Time curve—Sample A-5, air quenched from 1700°.

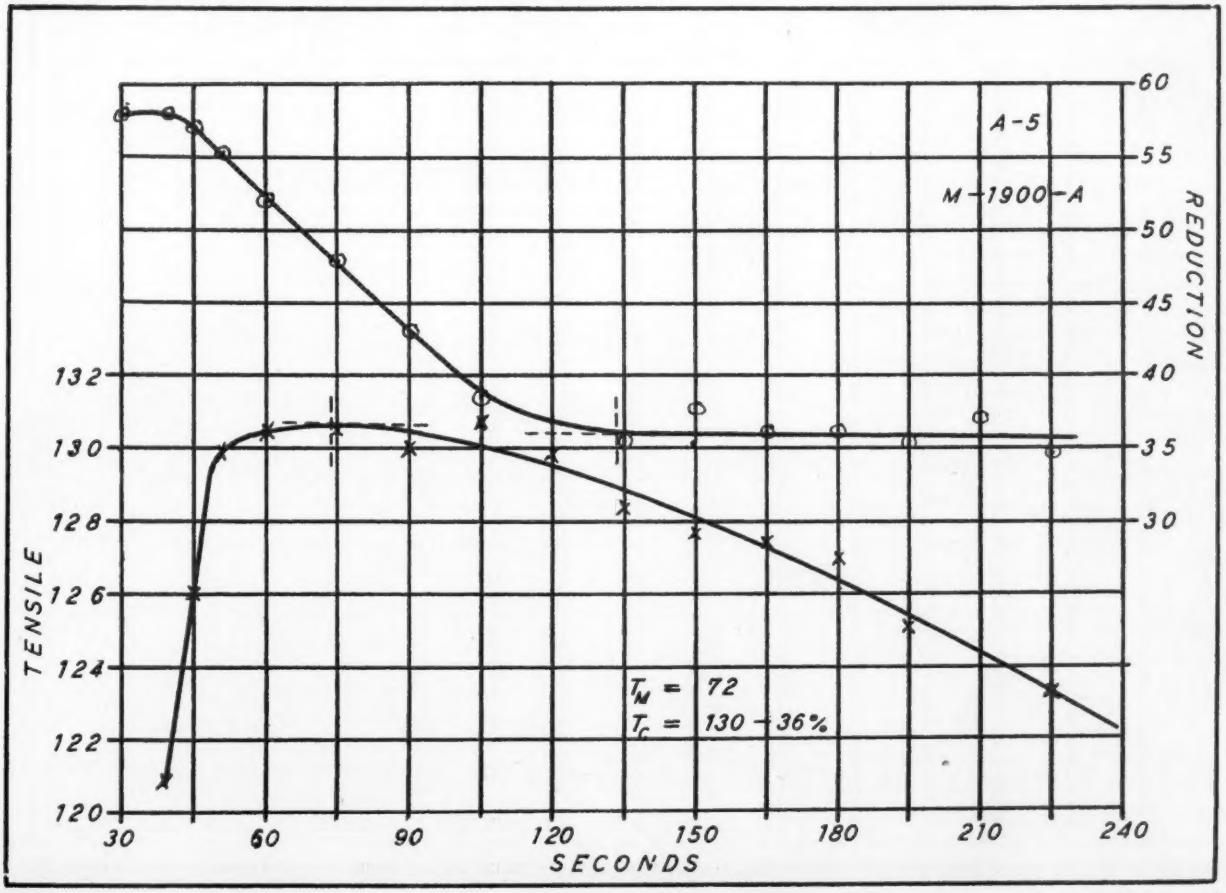


Figure 10. Time curve—Sample A-5, air quenched from 1900°.

in this case was 71 seconds. In lead heating and oil quench the times are nearly the same. This is only to be expected, since reflectivity is not a factor in conduction of heat.

✦ ✦ ✦

AN interesting side-light on the surface factor is given by a comparison of the temperature curves developed for samples C-1 and C-2. These two samples correspond in surface to 'A' and 'B' of Figure 14. The curves are shown superposed in Figure 5 to show that while there is considerable difference in time at the lower temperatures of muffle heating, there is practically no difference at high temperatures. The reason for this is probably the fact that at high temperatures the scaling action and breakdown of the existing surface condition occurs more rapidly than the absorption of heat, while at the lower temperatures, it is less rapid. Samples of C-1 and C-2 heated in lead (Figure 6) show a slight nearly uniform difference, a fraction of a second at most. It is possible that this difference may be due to the soap and lime coating existing on the C-2 samples which may conduct heat more slowly than the clean steel surface of the C-1 samples.

✦ ✦ ✦

THE effect of analysis on treatment time can be studied insofar as small variations are concerned by the examination of test results on comparable samples from the various steels listed in Table I. Although the possible selections are rather few, as presented in Table VIII, the time values listed are entirely in line considering the minor variations in size. It will also be seen later (Figure 16) that Steel E compares well with Steel A in relation to its size. The indications are, therefore, that within the 15 point range of carbon and the 11 point range of manganese covered by this work, treatment time is not affected by analysis variations. It is appreciated that these variations are not sufficient to show any measurable effect on critical temperatures, and any change in analysis which would affect critical temperatures would also undoubtedly affect treatment time in some degree.

✦ ✦ ✦

ANOTHER factor that might be expected to affect treatment time is the previous heat treatment the material may have received, or, more specifically, the structural form in which the constituents may exist. To show the extent to which this element may enter the problem, samples with the structures shown in Figure 15 were run through for comparison. Table IX gives a summary of the test results in terms of treatment time for muffle heating and oil and air quench. Here it is apparent that structure makes considerable difference in oil quenching, while in air quenching there is even more difference, although the trend is not clear cut. In the latter case, it is possible that the reduction in area values are affected by the presence of a heterogeneous structure in the treated samples.

✦ ✦ ✦

EXAMINATION of the results found for sample A-4 and sample B-1, both .250″ diameter, gives a very incomplete comparison of coarse and fine grain steels.

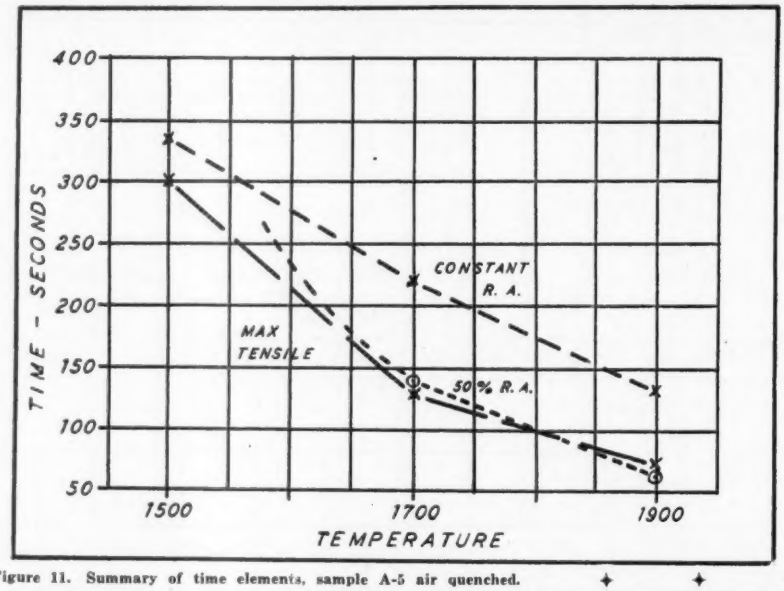


Figure 11. Summary of time elements, sample A-5 air quenched.

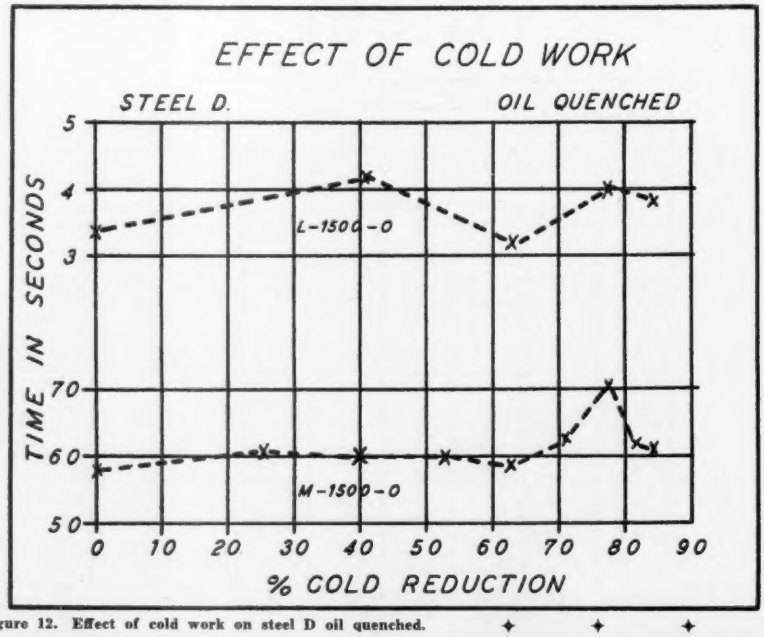


Figure 12. Effect of cold work on steel D oil quenched.

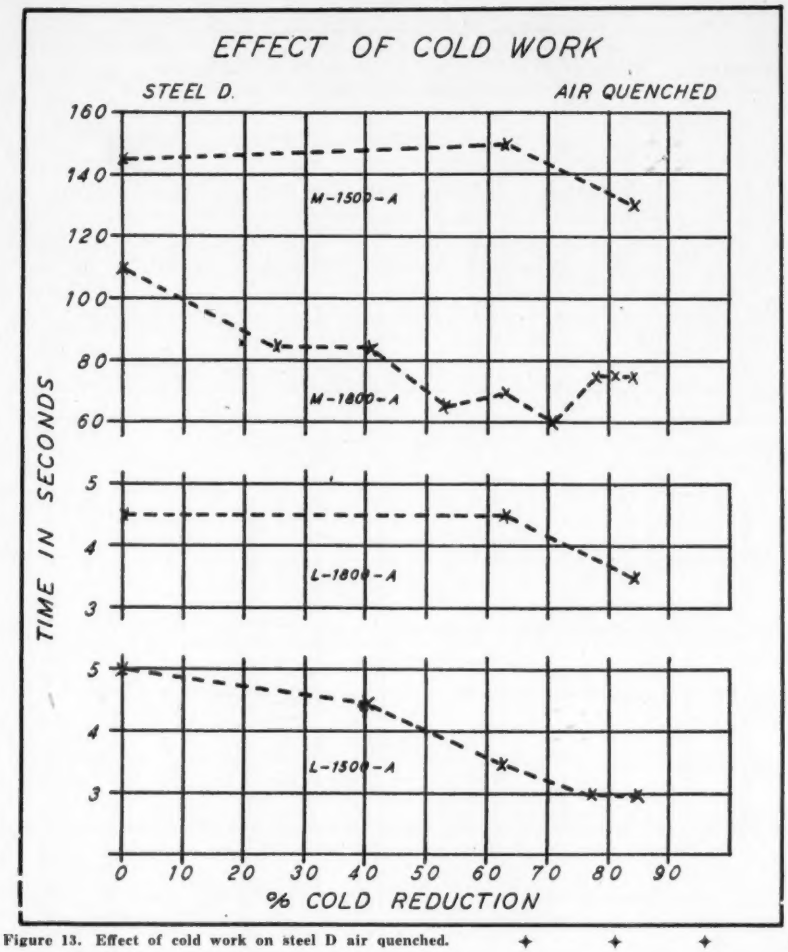
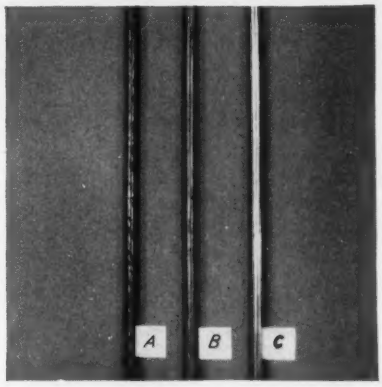


Figure 13. Effect of cold work on steel D air quenched.

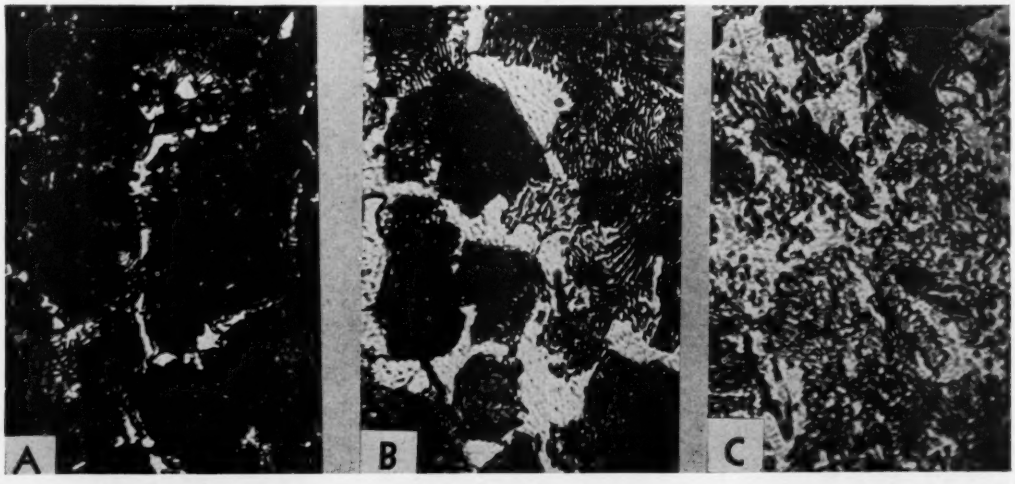


A. Patented & Pickled
B. Soap & Lime Drawn
C. Burnished

Fig. 14. Examples of surface characteristics, steel D.

The tests run, oil quenching from lead at 1500°, show time values of 10 seconds and 7 seconds for A-4 and B-1 respectively. This time difference may well be a reflection of the difference in reaction rates of the two types of steel. Comparison of sample B-5 with various samples of Steel D (all the same size) does not show, in similar treatments, as marked a difference in time values, but the general trend seems to agree with that above.

THE final and perhaps most important factor in the heating of steel wire dealt with in this paper is the mass influence, or effect of changing size. In theory, the quantity of heat required to raise the temperature to the treatment point depends on the weight of steel, which varies as the diameter squared. The area transmitting or absorbing heat is the surface of the wire, which, for any given length, varies directly as the diameter. Lastly, the distance the heat must travel is the radius of the wire, assuming uniform heating from all sides. Putting these factors together in the theoretical law, the time required for transmission of the necessary quantity of heat to attain the



Patented Commercial Process | 15 min. at 1500° Slow Cool | 12 Hrs. at 1280° Slow Cool

Fig. 15. Microstructures of steel D after various treatments. 1000X.

desired temperature varies with different sizes, all other factors being equal, as the square of the diameter. This theory takes no account of the lag in temperature while the steel passes through the critical range, nor does it take any account of time at temperature for full solution of constituents, for grain growth, or for any other accomplishment that may be the purpose of the treatment.

✦ ✦ ✦

A GRAPH of the test results on Steel A, from Table III, is given in Fig. 16 in which is shown a curve for the time required for full hardening (maximum tensile strength) when oil quenching from the muffle at 1500°, and also a curve representing the time at which greatest softening occurred, in the same treatment. In view of the complications of the heating action, it is impossible to compare this curve directly with the theory above. However, an empirical relation between size and time can be derived, and the means of doing so is illustrated in Figure 17 which is the hardening graph of the previous figure re-plotted in logarithmic co-ordinates. In addition, a graph of the various sizes treated in hearth contact (Table IV) has been added. Since the points plotted in this manner fall nearly in a straight line, an empirical law of the general form

$$T = k\, d^n$$

may be assumed, in which T is time, d is wire diameter, and k and n are constants to be established from the experimental data. It will be found that the graph of the results from samples treated with end contact only follows the law

$$T = 760\, d^{1.235}$$

✦ ✦ ✦

THE graph of the results from samples treated in full hearth contact gives different results for these constants, namely,

$$T = 1330\, d^{1.490}$$

✦ ✦ ✦

THE values of these two exponents might be compared with the theoretical value of 2. The reason for the difference lies in the fact that the measure of the time element which has been adopted automatically covers factors in the reaction of steel to heat

TABLE IX
Comparison of Metallographic Structures

Sample Symbol	Time in Seconds Required to Complete Process					
	Muffle Heating					
	Patented		Normalized		Spheroidized	
	Oil Quench 1500°	Air Quench 1800°	Oil Quench 1500°	Air Quench 1800°	Oil Quench 1500°	Air Quench 1800°
D-1	58	55	73	120	...	...
D-8	...	...	...	...	79	95

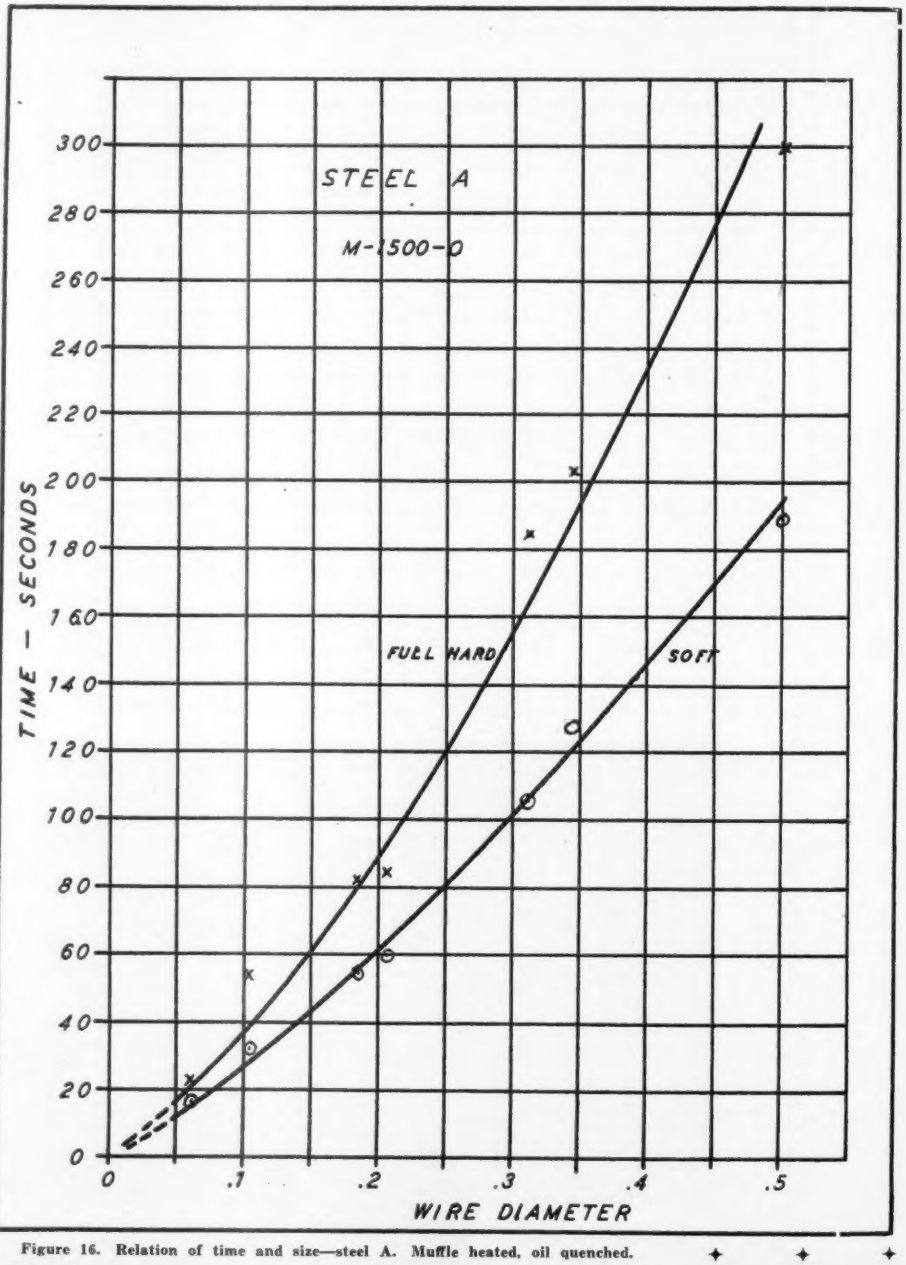


Figure 16. Relation of time and size—steel A. Muffle heated, oil quenched. ✦ ✦ ✦

treatment which the theoretical formula does not recognize at all.

✦ ✦ ✦

IT will be noted that the two curves of Figure 17 cross and that for sizes above about .112" heating in hearth contact takes longer, while for sizes under .112" the time is less than when there is no contact. This is undoubtedly because the heat content, that is, the quantity of heat, in the hearth of the particular furnace used for these tests was sufficient to bring the finer sizes up to temperature by conduction more quickly than heat could be absorbed by radiation, whereas, in the coarser sizes, it was not sufficient and the balance of the required heat had to come by radiation and also penetrate nearly twice as far. In comparing the two curves and their equations, it is fairly obvious that in the case of no contact radiation was the only mode of heating that was effective, while both radiation and conduction were acting simultaneously when there was full hearth contact. Thus, the fact that these two graphs and their equations are so different brings out strongly the complications introduced by the interplay of different modes of heating.

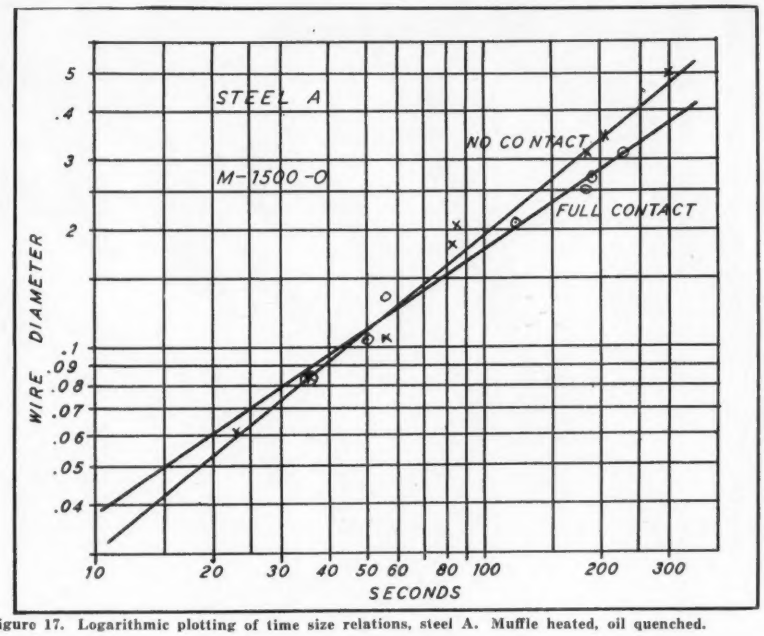


Figure 17. Logarithmic plotting of time size relations, steel A. Muffle heated, oil quenched.

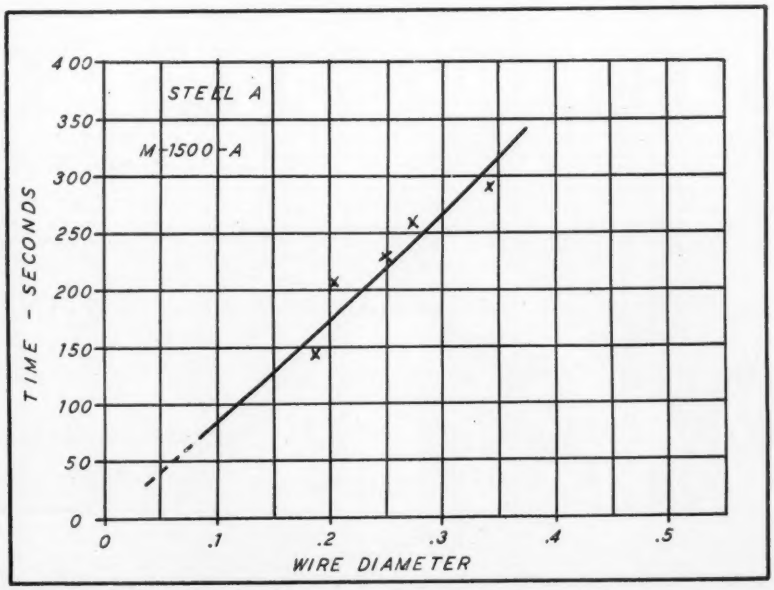


Figure 18. Relation of time and size, steel A. Muffle heated, air quenched.

✦ ✦ ✦

IN attempting to obtain the same type of graph for samples air quenched, there was not enough available sample of this steel for tests of very many sizes. The results obtained cannot be considered complete, but are presented for what they may be worth in Figure 18. This graph is based on the time required for the reduction in area to attain a constant value and represents samples muffle heated with end contact only. The empirical law indicated by these results may be of interest, and is found to be

$$T = 930\ d^{1.002}$$

✦ ✦ ✦

UNFORTUNATELY, it was not possible to treat a sufficient range of samples in lead heating to afford a reliable curve such as those given above. Indications are, however, that similar relations hold, the time scale being very much narrower due to the high conductivity of molten lead.

✦ ✦ ✦

Conclusions

IN summary of the results of this investigation the following conclusions may be drawn.

1. The heating medium employed in the treatment of steel wire is of prime importance to fixing the time of treatment. Conduction heating may be as much as 20 times faster than radiation.

2. Interplay of the modes of heating may cause large changes in the heating time required, depending on the characteristics of the heating equipment and the size of the wire.

3. Treatments for particular purposes carry inherent time values requisite for their proper completion. Patenting (air quenching) requires 2 to 3 times as long to complete as oil quenching, all other factors being equal.

4. Within the commercial range of analysis of a given steel, minor variations in carbon and manganese have no effect on treatment time.

5. Cold work has no effect on the time required for the completion of the treatment in the hardening operation, quenching in oil from either the muffle or the lead furnace.

6. A decrease in time required in air quenching from the muffle and from lead is found with the introduction of cold work. This decrease may be as much as 25% with wire having 85% cold work.

7. Required treatment time may be increased up to 35% in oil quenching and about doubled in air quenching

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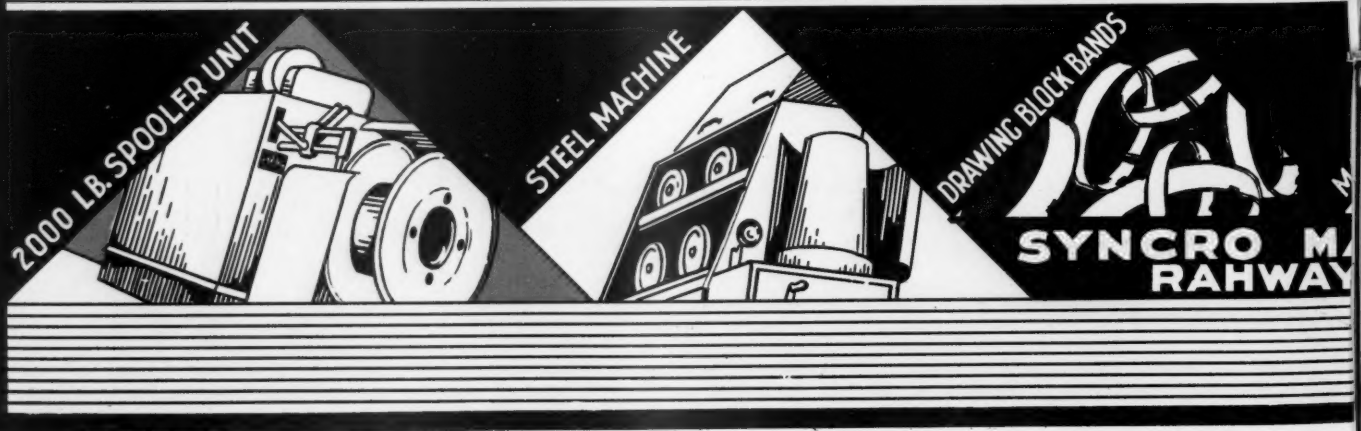

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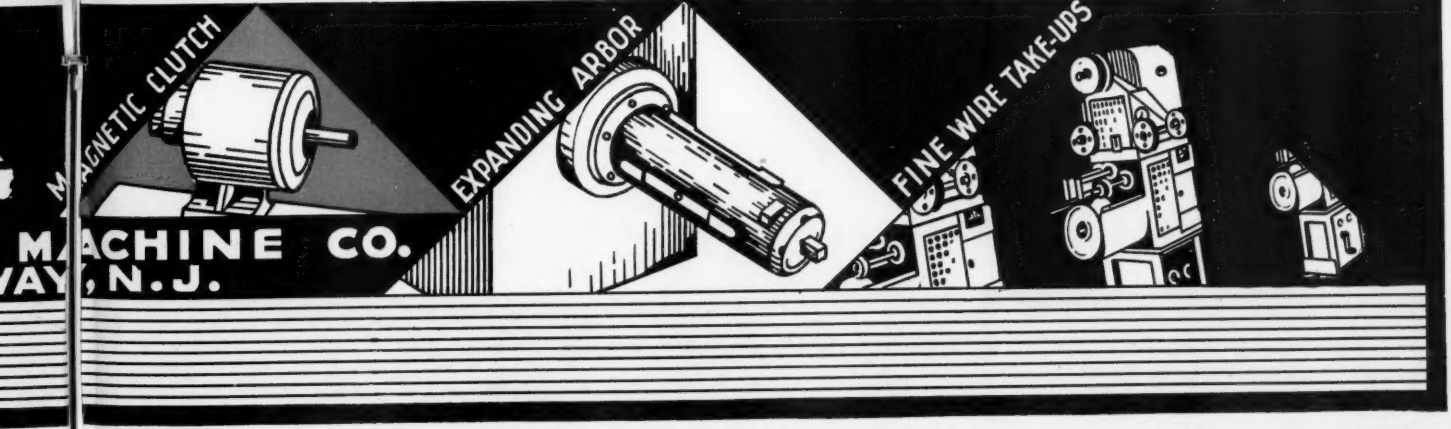

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High Speed Rotary Knitting Machine For Covering Electrical Conductors

By S. E. Brillhart,
Technical Staff,
Point Breeze Works, Western Electric Co., Baltimore, Md.

Knitted covers were developed largely to eliminate or greatly reduce noise associated with braiding and also to effect a reduction in cost for applying textile coverings. The machines described in this article operate at speeds as high as 4200 feet per hour. ✦ ✦ ✦ ✦ ✦

Purposes of Covering Conductors

THE main reasons for covering rubber insulated electrical conductors are to protect the insulation against deterioration resulting from light exposure, to protect it against mechanical injury and improve the abrasion resistance of the structure, to provide an absorbing base for weatherproofing materials in cases where the conductors are designed for outdoor exposure, to improve the insulating characteristics of the structure as a whole, and to improve the mechanical handling properties of the conductors.

✦ ✦ ✦

TO meet the requirements of these objectives the covering of textile material must be sufficiently close to exclude light penetration. It should be sufficiently well interwoven or knitted together to deflect sharp edged objects which might otherwise cut the rubber insulation, and rugged enough to withstand repeated rubbing on less sharp edges or surfaces. It should also be sufficiently porous and loose to absorb substantial quantities of weatherproofing materials but not loose enough to shed such materials readily during exposure to the elements. In some cases, coverings are also applied to conductors of low tensile strength and relatively fragile construction to improve their mechanical properties. In most of such cases the covering is intended to increase the tensile strength and the "lay" should be such that the strands of the covering make an angle of less than 45° with the axis of the conductor.

Machines Used for Applying Coverings

THE principal machines employed in applying textile coverings to electrical wires and cables have been circular looms, serving heads, braiding, and finally knitting machines.

✦ ✦ ✦

CIRCULAR looms are used principally when coverings must meet certain special purpose requirements as in the case of extremely high abrasion resistant coverings. They are, of course, very slow and coverings applied by them are expensive.

S. E. BRILLHART

Manufacturing Engineer, Rubber Covered Wire Division, Point Breeze Works, Western Electric Company, Baltimore, Maryland. Graduated in 1923 from Carnegie Institute of Technology with a degree of B.S. in Mechanical Engineering. Has been employed as follows: Apprentice Machinist and Toolmaker, Barry & Zacher Co. and Bearings Co. of America, Lancaster, Pa.; Toolmaker, Designer and Inspector, Emerson Engineering, Philadelphia, Pa.; Student Engineer and Assistant Operating Foreman, Cutler-Hammer Mfg. Co., Milwaukee, Wis.; Assistant Chief Engineer, Victor Talking Machine Co., Camden, N. J. First position in the Western Electric Co., was engineer in the development of switchboard lamps at the Hawthorne Works, Chicago, Ill. Was then transferred to Point Breeze and held various positions in the Rubber Covered Wire Division. Member of the American Society of Mechanical Engineers.

✦ ✦ ✦

APPLYING multiple end bands of textiles by serving or winding them about a conductor can be done at a much higher rate of output than with the circular loom, and when several such servings are applied in opposite directions, coverings can be produced which give satisfactory protection for certain purposes. The magnet wire designs are an example of this type which is generally used in making a more or less permanent structure such as a coil, in which the conductor will not be disturbed after the original construction is completed. Such coverings are not generally considered satisfactory for applications where the conductors might be repeatedly handled throughout their useful life, as is the case in most cordage, cable and outside plant wirings.

✦ ✦ ✦

ON the whole, braided coverings have been the most satisfactory general purpose type for application to cordages, cable cores and outside plant wires in the past, but they are relatively slow to apply and the machines for applying them are bulky, noisy, and relatively expensive to maintain. Braided coverings, unless the cotton is crowded, tend to show openings in the structure because the mechanical limitation of interweaving them leaves interstices

where the pairs of strands cross. They are often applied with the strands under considerable tension so that in certain applications the strands are prone to become imbedded in the rubber insulation beneath them, thereby tending to reduce the insulation resistance. This tension also makes it somewhat difficult to completely impregnate the covering with weatherproofing materials and limits the amount of these materials which can be contained in the textile covering.

✦ ✦ ✦

COMING finally to Knitting Machines with which this paper is principally interested, coverings applied by knitting might profitably be more generally used on wires and cables. Within the past few years the **Western Electric Company** at their **Point Breeze Works** in Baltimore has been applying weft type knitted coverings to several kinds of electrical conductors successfully in large quantities.

✦ ✦ ✦

SOME 1,000,000,000 conductor feet of telephone duct wire have been covered by a group of 40 units at speeds as high as 4200 ft. per hour. Recently, 80 more units have been built to cover this and similar items of rubber covered wires. In another application, a barrier has been knit on some 250,000,000 feet of cordage instead of a braid over which rubber insulation is subsequently applied, the finished conductor being used in telephone cords.

✦ ✦ ✦

WESTERN Electric knitters are also being introduced in Licensees' Plants for applying a knitted barrier in place of a serving or a braid, under SJ cord jackets, and some of these manufacturers also intend to use them in the production of duct wire and other rubber covered wires instead of braids.

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AS a further possibility of the use of knitters, it is suggested that a knit covering similar to samples 3 or 4 in Fig. 6 could be applied to field wire instead of braid. If such a substitution were made, the procurement situation on field wire might be considerably improved in times of war emergency because (1) knitting machines for covering large quantities of field wire could be built requiring a minimum of labor, material and experience on the part of the builder, and (2) each knitter put into service would cover field wire at approximately three and a half times the rate of the conventional rotary braider.

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Main Objectives of Developing Knitting

THE principal incentives the Western had for developing knitted coverings were to eliminate or greatly reduce the operating departmental noise associated with braiding, and to reduce the cost of applying textile coverings.

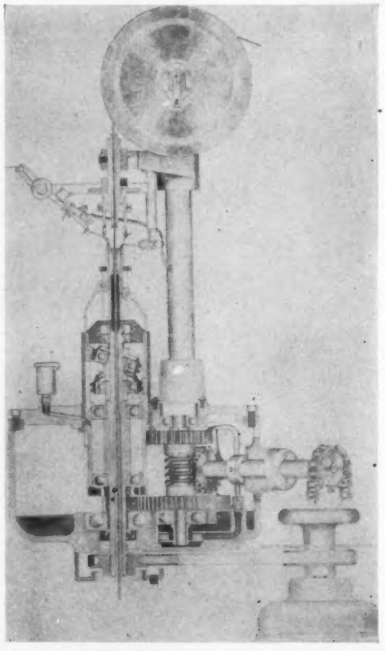

Fig. 1. View of Western Electric High Speed Knitting Machine Head.

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NOISE production in braiding operations results from (a) the necessity for using relatively heavy machine elements in order to rotate the textile supply packages about the conductor which is being covered, in the course of which, some part of the power absorbed in this rotation is likely to be converted into sound energy, and (b) the mechanical means employed for deflecting the strands over and under the packages while they are being thus rotated. In the case of the "Maypole" type braider there is likely to be considerable lost motion in the machine elements used, and in the conventional rotary type braider a relatively large number of reciprocating parts are employed which must be reciprocated at high rates of speed, both of which conditions produce noise.

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IN order to avoid these primary disadvantages of conventional braiders the Western developed a high speed rotary type braider some 12 years ago which substituted rotary escapement mechanisms and antifriction bearings for reciprocating parts and sliding pair bearings. This braiding machine operates at substantially twice the speed of previous rotary braiders and reduces the noise level appreciably. It also reduced covering costs because of the higher production rate per machine unit and lower maintenance costs per unit of product.

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MORE substantial reductions in noise and coverings costs could not be realized, however, as long as braided coverings were used because in braiding as well as in serving and circular loom covering, the textile supply packages must be rotated about the element to be covered, which requires the employment of heavy machine elements to resist contrifugal forces developed in rotating the supply packages and limits the operating speed. Thus, some covering such as weft type knitting should be employed which eliminates the necessity for rotating the textile supply packages.

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Development and Description Of the Knitter

THE development of the high speed knitter for covering electrical conductors followed a plan which had for its objects: (a) elimination of supply package rotation, (b) reciprocating the knitting needles by some means which would impart harmonic motion to them, and (c) providing flexibility for varying the knitted

pattern to fit special covering needs.

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THE choice of a different covering for conductors was not made in favor of knitting because it is better in itself than other coverings, but because a certain type of knit structure can be applied without rotating the packages. For instance, the conventional rotary hosiery knitting machine in which courses of loops spiral around the wire and in which the supply packages must necessarily rotate around the wire, would be an unsatisfactory choice. If a covering is chosen, however, in which the courses of loops lie parallel with the wire and the wales spiral around the wire, we have a better starting point because in this case the textile supplies or feeders lie in parallel lines along the axis of the core and is not necessary to rotate the supply packages. This non-rotation of the supplies makes feasible the design of a compact high speed machine.

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NOW the next factors which limited the speed of covering conductors became the rate at which the needles could be reciprocated and the length of loop permissible in the finished product. The principal design problem, therefore, became one of the developing mechanisms for reciprocating the needles as fast as possible without shock.

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WESTERN'S first designs of knitting machines raised and lowered the needles by employing fixed flat or cylindrical cams and intermediate links or cranks connecting with the butts of the needles. Such machines operated very much more rapidly and quietly than braiders but speed was somewhat limited because the cams, no matter how carefully made, could only approximate the proper form to move the needles with minimum shock, and the intermediate links used to transmit motion to the needles developed wear and lost motion with consequent increase in shock and noise production. Some improvement in the form of the cams was obtained by reducing the number of high points or rises and rotating them counter to the rotation of the needle cylinder, but this was at best only a partial solution.

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THE design of needle drive which was finally adopted raises and lowers the needles from a ball bearing mounted driver fixed on a center obliquely so that the rotation of the shaft wobbles the driver and reciprocates the needles which are engaged with its periphery. A number of such drivers may be needed in each knitting head depending upon the type of knitted covering which is desired. Figure 1 shows a cross-sectional diagram of the knitting head containing two drivers and their arrangement in service. The central shaft rotates in the same direction as the cylinder carrying the needles, but faster, and at whatever speed is necessary to produce the proper number of needle reciprocations per revolution. By this mechanism the needles are accelerated and decelerated at the ends of their travel with minimum shock. There need be no cross thrust on the butt of the needle as there is when needles follow a cylinder cam, because the periphery of the driver may be fixed with respect to the needles.

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THIS mechanism for reciprocating the needles also provides a flexible means for making many designs of knitted coverings, several of which are shown in Figure 2. The **single stitch** fabric with very short loops might be applied to products where severe repeated handling of the wire is necessary. This type covering could be applied at approximately 1750 feet per hour. The second example, usually referred to as the **Sinfra stitch,** consists of two separable coverings in which the loops cross over the feeders and are much longer than the loops in the single stitch. This covering could be applied at approximately 3500 feet per hour on the Western Electric Machine. In the third type shown, which we call the **Western Electric float stitch,** the loop lengths are slightly longer than the Sinfra stitch and float over the feeder similarly, but the covering is a single unit, not separable. This can be applied most rapidly of

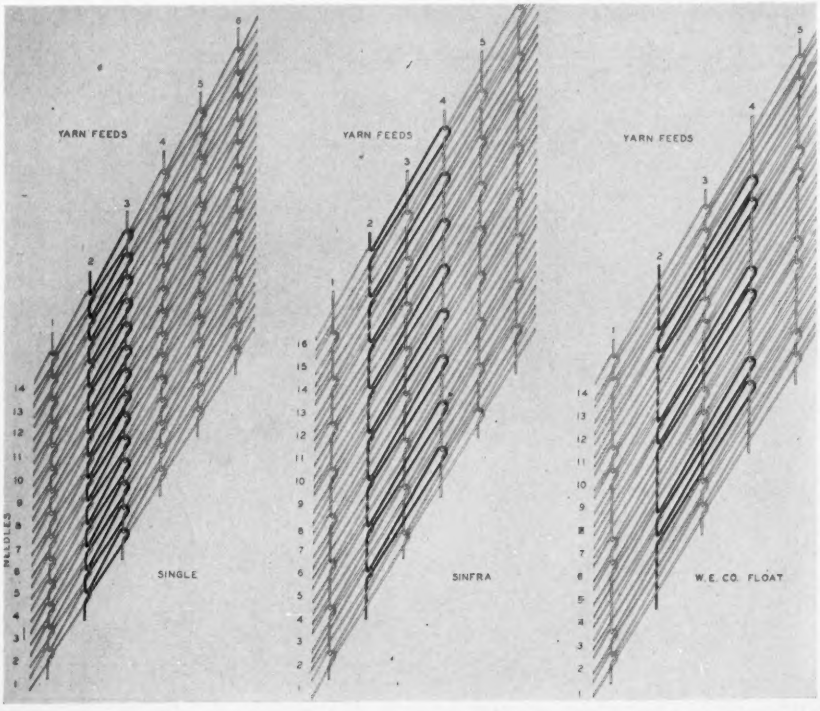

Fig. 2. Examples of knitted coverings which can be applied by the Western Electric High Speed Knitting Machine. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

the three shown, at speeds of the order of 4200 feet per hour. The latter two for example should be suitable for binding cordage cores which are to be subsequently rubber jacketed or for covering power wires which are later weatherproofed but not flexed much after installation. A general view of an individual machine arranged for covering rubber insulated wire of the size referred to in the above speed descriptions is shown in Figure 3.

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Performance

SO far as noise reduction is concerned, measurements were made with a sound meter of both knitters and braiders in operation. The results of these measurements showed that a single conventional rotary braider makes as much noise as 10 Western Electric knitters in operation. The improvement in working conditions that will result from such a noise reduction and the decreased operator's nervous fatigue can be best appreciated by those persons who have been and who work where a large number of conventional rotary braiders are in operation.

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THE rates of applying knitted coverings to conductors vary considerably with the size of the core to be covered and the type of knitted structure to be applied. To continue the comparison of speeds mentioned above table A shows the approximate output per hour on a wire with finished diameter of 1/10".

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FROM these figures a rough view of the reduction in plant investment and floor space can be obtained when knitters are substituted for braiders. For instance, if the Western Electric float stitch is serviceable for the product, each knitter would replace 14 conventional rotary type braiders. A substantial economy which has not been mentioned thus far also results from the use of knitters because mill wound supply packages are used just as received, whereas in the braiding machines these packages must be rewound to braider cops at an appreciable cost for labor and maintenance for rewinding machinery required.

TABLE A

	Nonstop Output in Feet per Hour
Flat "Maypole" type 16-carrier braider	77
Conventional rotary 16-carrier type braider	295
Western Electric 16-carrier high speed braider	535
Single Stitch, Figure 2, Item I	1750
Western Electric Machine, Sinfra Stitch, Fig. 2, Item 2	3500
Western Electric Float Stitch, Fig. 2, Item 3	4200

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FIGURE 4 gives a better view of a group of machines in operation in which the suppliers cotton packages can be observed in position on the machines.

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FIGURE 5 permits a comparison of the covering power and light protection obtainable with a knitted over a braided covering employing the same but rather low coverage. Both the braided and the knitted samples have been covered with identical quantities of cotton per unit length. These samples also permit a comparison of the possibility of improving the tensile strength in certain cases, for the braid covering sample shown here made from #20 AWG soft copper conductor with approximately .025" of rubber insulation covered with the braid developed after weatherproofing a tensile strength of 70 pounds, whereas the knit covered sample with the same quantity of cotton on it had a strength of 76 pounds.

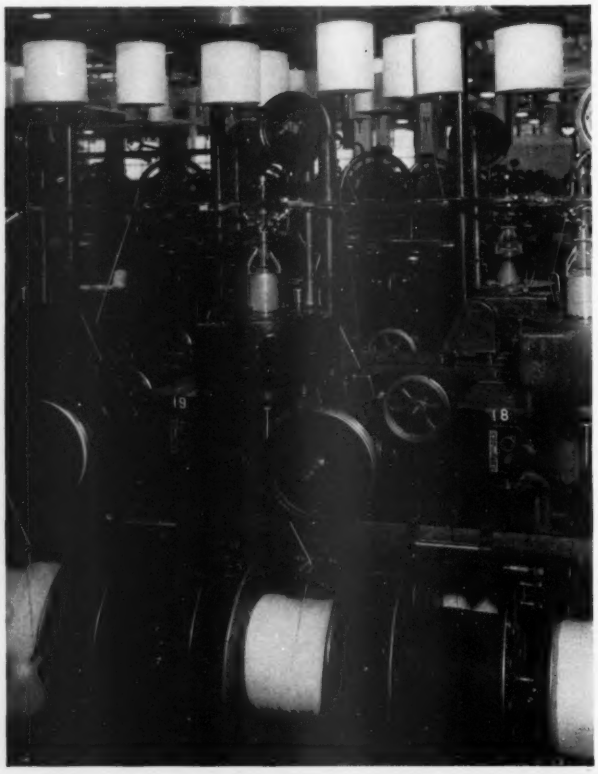

Fig. 3. View of a Western Electric knitter as used to cover a typical rubber covered wire.

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IN cases where abrasion resistance is important there is evidence that coverings as resistant as braids can be applied by knitting, although actual service results are not yet available.

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FIGURE 6 shows typical samples of wire in which the abrasion resistance of weatherproofed finished material was measured by attaching samples to the arms of a rotating wheel and in a combination of transverse and longitudinal rubbing, rub these samples against fixed braided and weatherproofed wires with coarser covering.

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SAMPLE 1 is a braid covered wire, shown weatherproofed and finished as Sample 2, which was used as the control in comparing the abrasion resistance of Samples 3

and 4 after they were weatherproofed as shown by Sample 5.

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SAMPLE 3 had as nearly the same weight of cotton relative to Sample 1 as could be applied. This was done to get a close comparison of the abrasion resistance of the braid and the knit. The cotton on the knitted sample is 3½% heavier than that on the braid. In the particular form of abrasion test Sample 3 withstood abrasion 25% better than the braided control Sample 1. That is, if the number of rubs Sample 1 resisted before wearing through is called 100%, then Sample 3 withstood 125% of that number before failure.

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SIMILARLY knitted sample 4 although having 22% more cotton than Sample 1, withstood abrasion 41% better.

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SAMPLES 6 and 7 are braid covered telephone drop wire control samples. Samples 8 and 9 are double knit covered drop wire samples which were compared in abrasion resistance with Sample 7 after weatherproofed as Sample 10. ✦ ✦ ✦

SAMPLE 8 once again was intended to have the same weight of cotton applied as Sample 6, but in this case had 3% less. In the form of abrasion test used it performed 7% better than the braided Sample 6. Knitted Sample 9 had 6% more cotton than braided Sample 6, but in the above test it withstood abrasion 29% better than Sample 6.

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THESE samples are cited to indicate the practicability of designing knit covers which will be the equivalent of braided coverings in abrasion. It is not to be concluded, however, that knitted coverings will perform better than braids with he same quantity and grades of covering materials, but it seems fairly reasonable to ex-

(*Please turn to Page 659*)

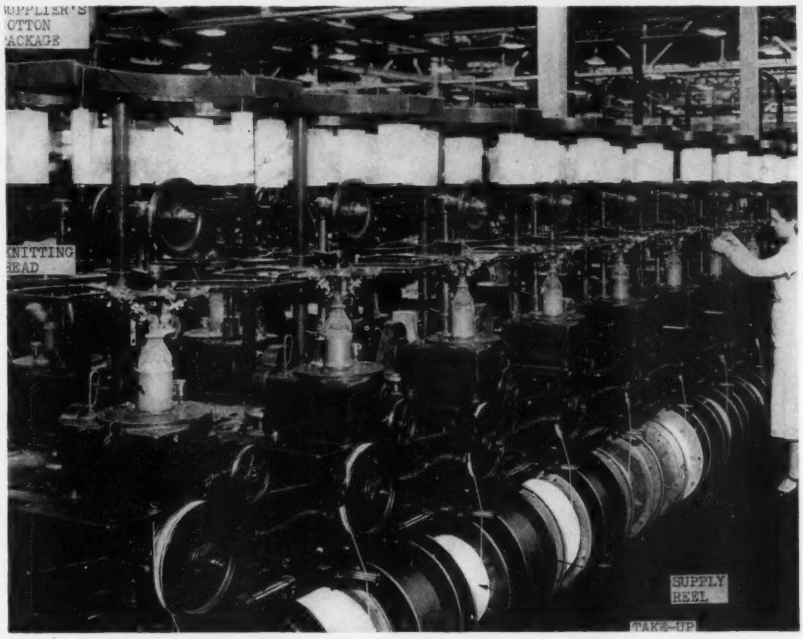

Fig. 4. General view of Western Electric knitters in operation. ✦

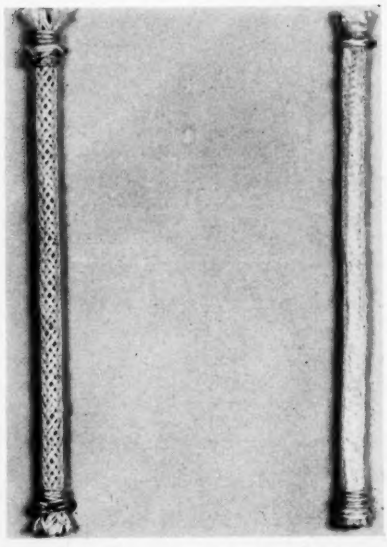

Fig. 5. Illustrating the more light protective covering obtainable with a given small weight of cotton by knitting. Both the braid and the knit cover use the same weight of cotton. ✦

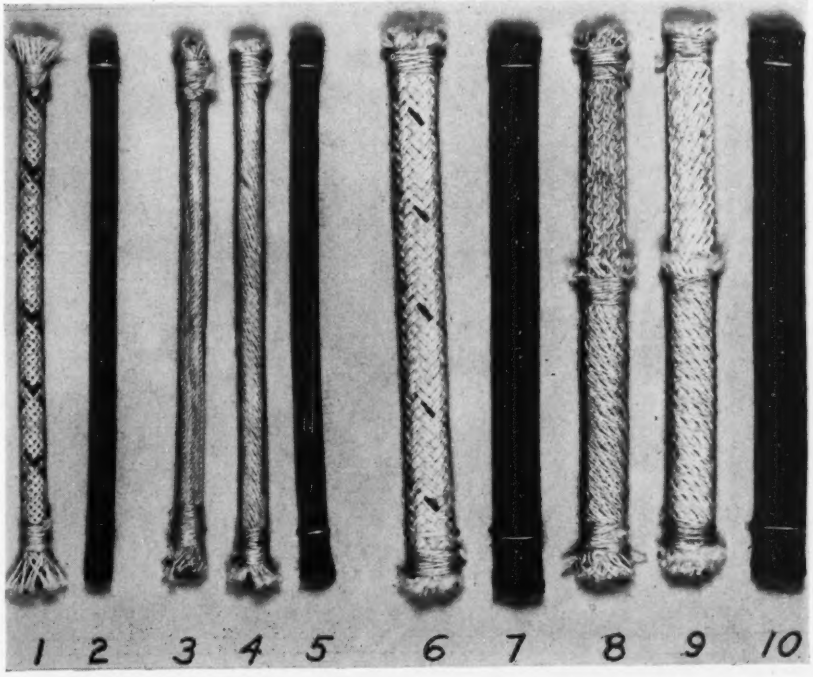

Fig. 6. Samples of wires used for comparing abrasion resistance of braids against knits. ✦

The American's Creed

I believe in the United States of America as a Government of the people, by the people, for the people, whose just powers are derived from the consent of the governed; a democracy in a Republic; a sovereign Nation of many sovereign States; a perfect Union; one and inseparable; established upon those principles of freedom, equality, justice and humanity for which American patriots sacrificed their lives and fortunes.

I therefore believe it is my duty to my country to love it, to support its Constitution, to obey its laws, to respect its flag, and to defend it against all enemies.

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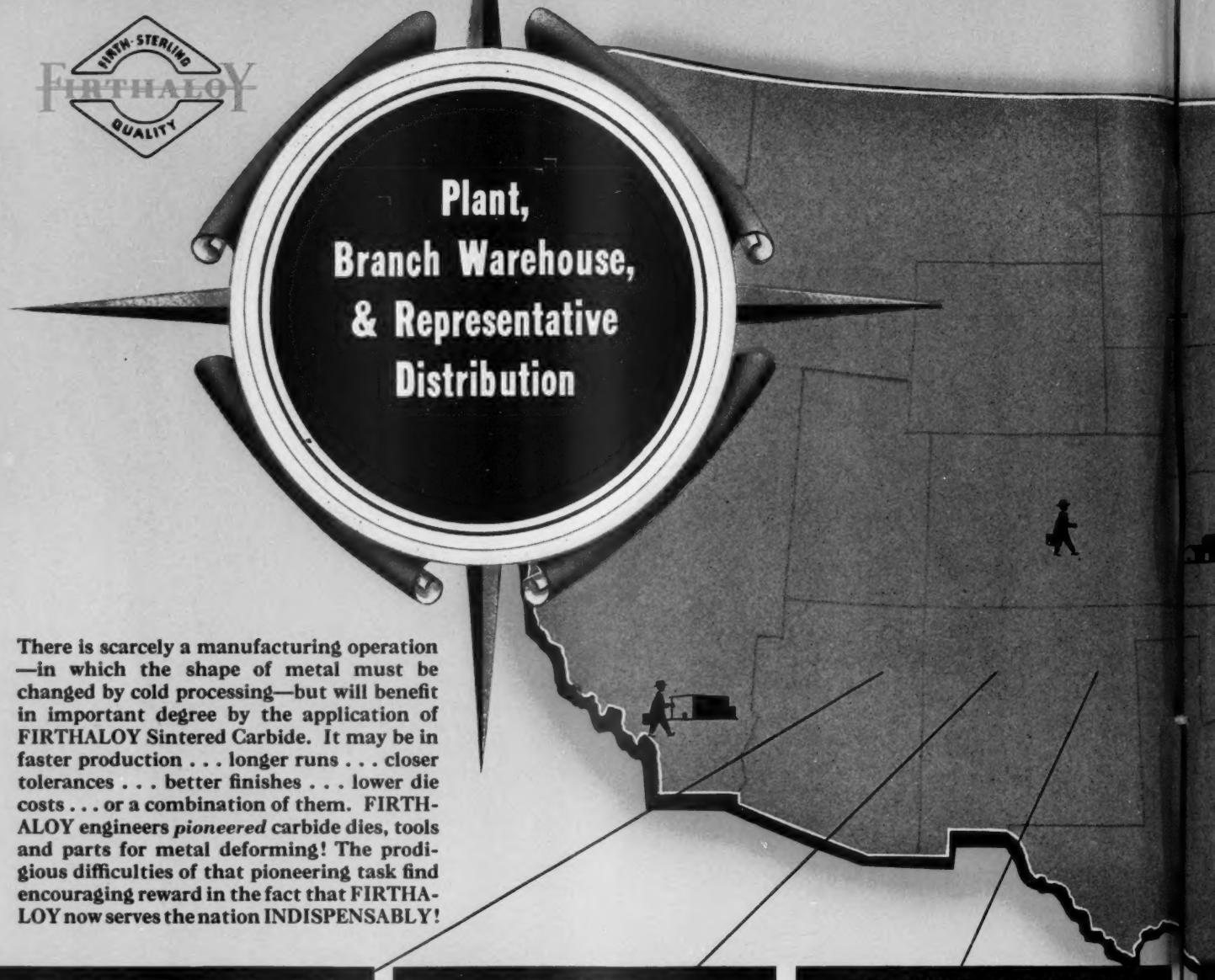

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CROMOVAN TRIPLE DIE STEEL—is a patented high production die steel, (an improvement on the usual high-carbon-high-chrome type) possessing extraordinary hardness and strength. It shows unusual resistance to abrasive wear, corrosion, chipping and crumbling, and to sinking or yielding under pressure. Die makers find it can be machined and filed more easily and more rapidly than other types. Cromovan may be *air*- or oil-hardened.

AIRVAN AIR HARDENING STEEL—is a Chrome-Molybdenum-Vanadium die steel containing less of these alloys than Cromovan. It is used where an air-hardening die steel cheaper than Cromovan is desired for applications not requiring highest possible production. Airvan also finds satisfactory application in many places where the oil-hardening, non-shrinking type has been used.

INVARO OIL-HARDENING STEEL—is a "center-free" steel made by the Firth "Winged" Ingot process. It is of the "non-shrinking" type and is used for dies for Blanking, Trimming, Punching, Forming, Embossing, etc. Invaro is also used in special tools where it is important that there be no dimensional change in heat-treatment.

SPECIAL A.S.V. STEEL—is a "center-free" high quality carbon tool steel cast in the Firth "Winged" Ingots. It is remarkably uniform in structure throughout and is recommended for applications where "homogeneity" is desired. The patented process of casting Special A. S. V. Steel eliminates, as evidenced by Acid Etch Test, pipe, porous center, and non-metallic inclusions. Special A.S.V. Steel is the latest development in a superior water-hardening steel. It has a homogeneous structure that forges well, hardens uniformly and has a strong tough core, suitable for Blanking Dies, Cutting Tools, Forming Dies, Punches, Stamping Dies and Cold Heading Dies. Special A.S.V. Steel is highly resistant to strain and fatigue.

J-S CHISEL and PUNCH STEEL—is an OIL-HARDENING steel. It is exceptionally tough and shows remarkable resistance to the "fatiguing" effect of repeated blows. It adapts itself readily to purposes requiring a good cutting edge or hard surface in connection with the greatest possible toughness and resistance to crushing strain. It is particularly adapted for Chisels, Punches, Shear Blades, Rivet-Sets, Beading Tools, Mining Drills, and many other similar purposes.

CHIMO CHISEL STEEL—is a tough AIR-HARDENING steel which offers high resistance to fatigue. It possesses excellent wearing properties and will retain a sharp cutting edge in the severe service of pneumatic chipping chisel operations on hard steel. It is manufactured from ingots made by the patented Firth "Winged" Ingot method. It is a high quality "center-free" punch and chisel steel.

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FIRTHITE—is a hard metal composition of Sintered Carbides, furnished in a number of grades, to form the edges of cutting tools or wearing surfaces. Firthite tools have greatly increased cutting capacity and remarkably long life. Write for prices on finished or unfinished tools and blanks.

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Production of Commercial Bronze Screen Cloth Wire

By Benjamin H. McGar
Assistant Director of Research
Chase Brass & Copper Co., Waterbury, Conn.

A description of the processes for producing commercial bronze screen cloth wire either from hot rolled billets or from cold rolled rods to produce a wire that will conform to present federal specifications. ✦

DURING the past decade the increased demand for Commercial Bronze screen cloth for domestic purposes has augmented the requirements for a large volume of suitable weaving wire from the mills. Naturally this has prompted engineers to design more efficient wire drawing equipment for greater production at lower cost, whenever possible. Of course, remarkable progress has been made in drawing wire since the fifteenth and sixteenth centuries, as is depicted in Figure 1, and great strides have been made in producing wire more economically, faster and of better quality.

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Federal Specification Compliance

IN order to comply with Federal Specifications, Commercial Bronze weaving wire must contain 90-92% copper, balance zinc. The standard gauge wire is 0.0113", although some sub-standard wire is produced at 0.010" and 0.009". There are well established processes for producing this wire—one from hot rolled billets, and the other from cold rolled rods.

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Rod Production

THE hot rolling method begins with either a round or square billet of various dimensions which is best suited for the hot rolling equipment. When square billets are required they are sometimes cast 3¾" square with a tapered point on one end; the overall length is about 50", and the weight approximately 250 lbs. The billets are heated in any conventional type furnace until the metal has attained a temperature approaching 1500°F., and then hot rolled in 7 passes through the roughing mill, followed by 9 passes through the intermediate and finishing rolls, making a total of 16 passes to bring the rods down to $\frac{5}{16}$" round. At this point the rods are ready for further surface treatment before they are reduced on the wire drawing machines. Figure 2 shows a photomicrograph of a Commercial Bronze casting showing the usual dendritic cast structure. Figure 3 is a photomicrograph of a hot rolled $\frac{5}{16}$" rod showing evidence of deformation and recrystallization. Such a rod has a tensile strength of 38,000 pounds per square inch, and elongation of 53% in 2".

BENJAMIN H. McGAR

Graduated from Wesleyan University in 1936, with B.S. degree in Chemistry. 1916-1918 employed by Chase Metal Works as Analytical Chemist. 1918-1923 Chief Chemist, Bristol Brass Company, Bristol, Conn. 1923- Chief Chemist, Assistant Director of Research, Chase Brass & Copper Co., Waterbury, Conn. Has been actively engaged in various branches of chemical engineering, such as the production of wrought copper and brass, metal reclamation, lubrication, electro-deposition and metal finishing. Author of "Copper and Its Alloys—Their Development and Uses", "Annealing Brass and Copper in Controlled Atmospheres", "Finishing Operations on Copper and Brass Sheet", "Sheet Brass for Photo-Engraving and Etching", "Lubrication of Metals for Fabrication and Cutting". Member of American Chemical Society, Electrochemical Society, American Electroplater's Society, American Institute of Mining and Metallurgical Engineers and A. S. T. M. Committees: B-8—Electrodeposition of Metallic Coatings and E-3—Chemical Analysis.

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Cold Rolling Commercial Bronze Rod

FOR clarity at this point, the production of $\frac{5}{16}$" cold rolled Commercial Bronze rod will be described in detail. Cast in round cannon moulds, the rods are 2" in diameter, 8½ ft. long, with a tapered point on one end, and weight approximately 100 lbs. The castings are first drawn on a rod drawing bench to 1.875" in order to straighten and stiffen them; this operation is followed by removing the cast surface of the rods in a rotary scalper to 1.75" diameter. The rods are then given 5 passes through grooved rolls on the roughing mill to 1.130", followed by 6 passes through an intermediate mill to 0.750" square. On the last pass the rods are rolled into coils 28" in diameter, and in this condition the metal is annealed in a batch type furnace at 1250°F. for one and one-half hours. After cooling to room temperature the annealed oxidized rods first go through a 5-roll straightener, and then pass through 10 pairs of grooved rolls of graduated reduced sizes which bring the rods down to 0.325" square. At the end of the mill the rods are again formed into coils 24" in diameter. Figure 4 shows a cut of a 10-stand mill which is 24 ft. long, 3 ft. wide and 4½ ft. high. This is operated by a 125 H. P. variable speed D. C. motor, and the finished rods come from the machine at the rate of 150 ft. per minute. The 7" diameter case hardened alloy steel grooved rolls are geared independ-

ently of each other in order to prevent slippage during the rolling operation. Table I shows the groove sizes of the individual rolls, and the approximate reduction of the 0.750″ square rods to 0.325″ square.

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Lubricants

A LUBRICANT composed of 85% Machine Oil, 10% Kerosene and 5% Lard Oil is flowed continuously on to each roll during operations, and the lubricant falls into a trough which runs the full length of the mill and is collected in a tank beneath the floor. From here it is pumped through a filter which removes any grit or sharp particles that might be injurious and re-distributes the oil on to the rolls. All bearings are lubricated with a suitable grease by means of a semi-automatic lubricating system, and telltales or indicators on each grease line to the bearings are in plain sight of the operator.

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Annealing and Welding

THE 0.325″ square rods are next annealed for one and one-half hours at 1250°F., and following this operation they are pickled in a 10% sulphuric acid solution and then thoroughly washed in water. They are then welded to make one continuous coil and drawn down, in the presence of a water emulsion lubricant, to either $\frac{5}{16}$″ or $\frac{1}{4}$″ round and again annealed and pickled. Figure 5 is a photomicrograph of annealed cold drawn rod.

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Figure 1. ✦ ✦ ✦ ✦ ✦
Tréfilage A L'Escarpolete (XVe Siècle)

Tréfilage Sur Table (XVIe Siècle)

Surface Treatment for Color

BOTH the hot rolled rods and the cold drawn and annealed rods are now on a similar size and have nearly the same physical properties. At this point the surface treatment of the rods is highly important as it will determine to a great degree what shade or color the finished wire will have. Three well-known methods are employed, for cleaning or dip-

TABLE I

No.	Roll Groove Size Inches	Approximate Reduction of Area — Percent
1	0.652	24
2	0.601	15
3	0.554	15
4	0.511	15
5	0.472	15
6	0.434	15
7	0.400	15
8	0.369	15
9	0.340	15
10	0.325	9

Total reduction of 0.750″ to 0.325″ square rod, approximately 81%

TABLE II

No.	Die Sizes Inches	Approximate Reduction of Area — Percent
1	0.250	35
2	0.204	33
3	0.165	36
4	0.138	29
5	0.118	27
6	0.098	32
7	0.086	23
8	0.072	29
9	0.060	32
10	0.051	29

Total reduction — 96%

Figure 2. ✦ ✦ ✦ ✦ ✦ ✦

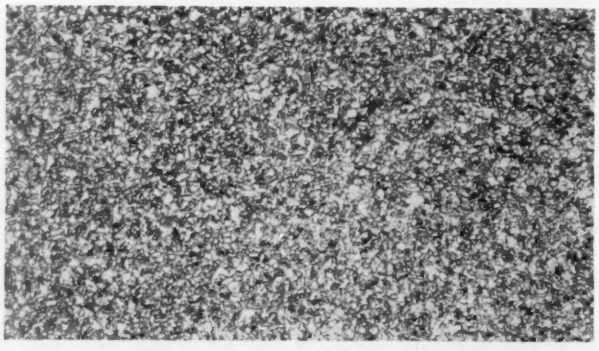

Figure 3. ✦ ✦ ✦ ✦ ✦ ✦

ping the rods, and these are as follows:

1) **10% Sulphuric Acid Solution**
2) **Sodium Dichromate Dip**
3) **Nitric-Sulphuric Acid Dip**

✦ ✦ ✦

10% Sulphuric Acid Pickle

WHEN rods are treated in this solution only, they have a decided red color which closely approximates that of copper and in spite of the numerous drawing operations to 0.0113″ the finished wire will still have a decided red cast. Sometimes, however, this finish is desirable when some special treatment is to be applied to the finished product.

✦ ✦ ✦

Sodium Dichromate Dip

RODS treated in this dip are first pickled in a 10% sulphuric acid solution, and upon removing are thoroughly washed and immediately placed in the dichromate bath which is made up by adding one-half pound of sodium dichromate per gallon of a 10% sulphuric acid solution. When the bath is new the action is quite rapid so that it is only necessary to permit the rods to stay in the solution for a short time. As the bath becomes weaker, a longer period is needed in the solution to obtain satisfactory results. The bath can be temporarily revived by adding more acid, dichromate, or heat by means of a closed lead steam coil, or the combination of all three. Rods so treated have a golden red color much lighter than those just treated in the sulphuric acid pickle. Too much emphasis cannot be given to the necessity for thoroughly washing the wire after this treatment, as a small amount of residual dichromate solution on it will greatly impair the subsequent drawing operations.

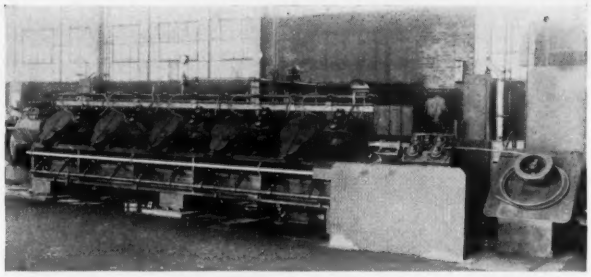

Figure 4. ✦ ✦ ✦ ✦ ✦ ✦

✦ ✦ ✦

Nitric-Sulphuric Acid Dip

THE rods should first be pickled in a 10% sulphuric acid solution until all the heavy oxides are removed; then the coils should be thoroughly washed in water. Following this, the rods are placed in the dip which is composed of 50% Sulphuric Acid, 35% Water and 15% Nitric Acid (by volume). The action is very rapid, and the metal should be left in the dip for only a short time before it is removed and immediately submerged in a tank of running water. Treatment in this dip imparts to the metal a light golden color which is characteristic of the Commercial Bronze alloy. If the rods are stained because they have been in the air too long they may be given a very quick dip in a dichromate solution in order to bring them all to a uniform color.

✦ ✦ ✦

AFTER thorough washing, the rods are dipped in a hot soap solution made up by adding one-half pound of either powdered or chip soap to a gallon of water. This operation may be performed on rods finished in any of the other cleaning solutions, and it is done for two reasons. The light soap film protects the rods from tarnishing during shipment or storage, and also aids as a lubricant on the next drawing operation.

✦ ✦ ✦

THE equipment that is necessary for the nitric-sulphuric acid dip is much more extensive than that for the other solutions. An acid resisting steel tank is the most practical one to use, and suitable provision must be made for exhausting the fumes which rise off the dip tank; otherwise it would be next to impossible for the workmen to operate near such a solution with any degree of comfort.

✦ ✦ ✦

Wire Drawing

ASSUMING now that the rods are the proper size, temper and finish, they are ready to be drawn into wire suitable for the screen cloth manufacturer. No standard procedure has been adopted by the industry for reducing the rods to the wire sizes required, and it is a well-known fact that the practice differs a great deal between various mills. No attempt will be made to describe these variations, and only one procedure will be considered at this time.

(*Please Turn to Page 653*)

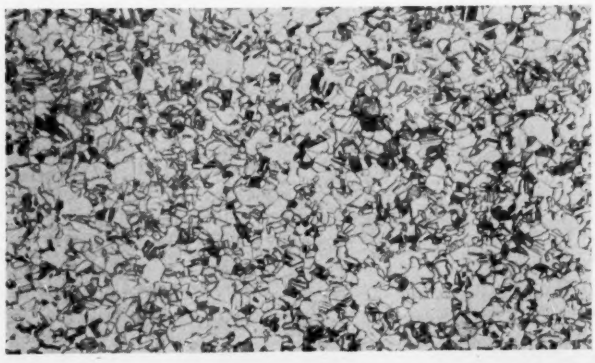

Figure 5. ✦ ✦ ✦ ✦ ✦ ✦

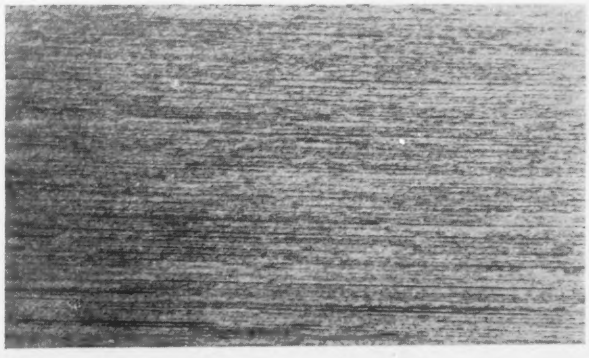

Figure 6. ✦ ✦ ✦ ✦ ✦ ✦

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Diamond Dies For The High Speed Drawing of Copper Wire

By H. N. Padowicz,
Engineer,
Western Electric Co., Kearny, N. J.

A study of the problems involved in the use of diamond dies for drawing copper wire at high speeds of 10,000 to 12,000 feet per minute, together with a description of the maintenance, inspection and course keeping records in connection therewith.

ESSENTIAL to the drawing of copper wire at any speed are the dies to effect the desired reduction steps. It can be readily surmised that this item is one of major importance at drawing speeds of 10,000 and 12,000 feet per minute which are being used in the copper wire drawing plants at the **Kearny Works** and the **Baltimore Works** of the **Western Electric Company.**[1] In these machines diamond dies are used to draft 12 and 14 A.W.G. supply wire to the final sizes of 19, 22, 24 and 26 A.W.G., respectively. As pointed out in the paper[1] describing these machines in the above noted plants, the maximum possible drawing speed is limited by the stresses set up in the take-up reel rims. Drawing dies in themselves should not place any limitations on the wire drawing speeds if the factors of heat generated and the rapid movement of lineal wire surfaces are logically considered and provided for.

✦ ✦ ✦

IN 1924 the manufacture of copper wire at a drawing speed of 2500 feet per minute in a new type of wire drawing machinery, developed and designed by the **Western Electric Company**, was started in its Chicago plant.[2] At that time copper wire was being generally produced at speeds ranging from 800 to 1200 feet per minute. A study of the manufacture of diamond dies for use in these machines developed that dies suitable for this work required a differently shaped "approach," a better polish and a shorter "land" than those that were available for low speed operation. These same factors are still the important items which must be considered for today's drawing speed of 10,000 and 12,000 feet per minute.

✦ ✦ ✦

THE technique of making diamond dies for the drawing machines which operate up to about 5,000 feet per minute is now well established. The specifications covering the dies for this purpose are known and available to the trade which is well qualified to produce them. However, the opportunity and necessity for diamond dies to draw copper wire at the noted high speeds did not exist prior to the recent development of these high speed machines and for this reason the industry was not familiar with the necessary die requirements.

H. N. PADOWICZ

Graduate Chemical Engineer, Ch.E. Rensselaer Polytechnic Institute, 1928. Metallurgical Engineer, Westinghouse Lamp Company on research and development work in powdered metals, wire products, etc. Metallurgical Engineer, Sirian Wire and Contact Company on development work pertaining to the refractory powdered metals, cemented carbides, wire products. Since 1937 with Western Electric Company, Kearny, New Jersey, in connection with metallurgical control, wire drawing and cable developments. Member of the American Society for Metals, Wire Association.

✦ ✦ ✦

THE **Kearny** Wire Mill was set up to purchase finished mounted dies from outside suppliers and to recut them when oversize. These dies are usually acquired at the smaller final sizes as governed by production schedule requirements and enlarged to the larger sizes for both finisher and line die use. A large part of the success attained was due to specifications defining the die requirements and the setting up of adequate inspection means to check the new and recut dies for these requirements. Prior experience of this company and the cooperation of our suppliers greatly sided this policy.

✦ ✦ ✦

THE following details of diamond wire drawing dies have been found to be essential to the desired performance of these tools in our drawing operations:

Shape and Quality of the Diamond Stone
Stone Size
Mounting
Contour of the Die Hole
Polish and Finish
Pounds Pull to Draw the Wire through the Die

Shape and Quality of Diamond Stones

ROUND, clear stones of sound structure are selected and these should be free from cracks, pits, carbon spots, porosity or any flaws and imperfections which would affect the present or recut drawing surfaces of the die. Round is the trade term for stones of polyhedral sides, approximating round, or roughly spherical form as distinguished from flats and irregular, unsymmetrical shapes.

✦ ✦ ✦

USUALLY these stones are octahedral in habit with smooth rounded corners. The coloration and clarity of the mounted stone should permit inspection of all drawing surfaces, relief angle, approach angle and bell. A close grained stone as determined by the crystal growth lines seems best.

✦ ✦ ✦

Stone Size

THE size of stone for specified hole sizes, consistent with the quality of stone previously noted, has been well standardized for the copper wire industry by the American wire die manufacturers. Good die performance has been obtained from these sizes. The average stone size of these manufacturers has been specified for our requirements.

✦ ✦ ✦

Mounting

THE mounting encasing the stone is a vital factor in the life of diamond wire drawing dies. Diamonds when used for drawing dies ultimately fail by breakage (i. e. cracks, spalling, chipping out) and not by erosion of the wearing surfaces. Diamonds due to their formation and crystalline structure and to the physical properties resulting therefrom, are particularly prone to breakage when subjected to fatigue, impact and disrupting tensile stresses such as those commonly met in wire drawing operations. To compensate for this weakness it is necessary to effectively encase the stone in a mounting which adequately supports it on all sides. The methods of mountings are many and varied. Mountings which are made by hot pressing, forging or upsetting to obtain definite bonding of the component parts were found to be superior to those made by brazing, puddling, or casting. High strength metals processed with the proper technique to effect good metal flow and alloying bonding are preferable. The interface of the stone and metal should be free from porosity and crevices. Figure 2 depicts a defective mounting due to poor metal flow which caused the early breakage of the stone.

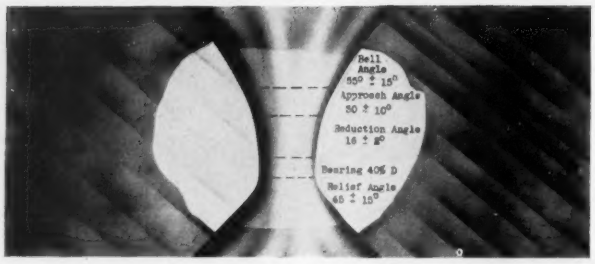

Figure 1.

✦ ✦ ✦

Contour of the Die Hole

THE contour of the die hole is shown in Figure 1. It is the familiar radial or parabolic type which is commonly used in the copper wire industry with good results. The straight angles associated with cemented carbide dies do not exist in the present day commercial diamond dies. The noted angles are arcs and the values cited refer to the average chords subtending these arcs. In agreement with the findings of comparatively recent English investigations[3] of the theoretical factors affecting wire die performance, it was found that small changes of angle do not appreciably influence the die pull. Whatever differences do exist are blanketed out by changes in the die frictional forces. The permissible variations in angle are consistent with the average found in today's best commercial dies. In recutting dies obtained from different sources the variations narrow after one or two recuts. This is to be expected when standardized recutting practices are followed.

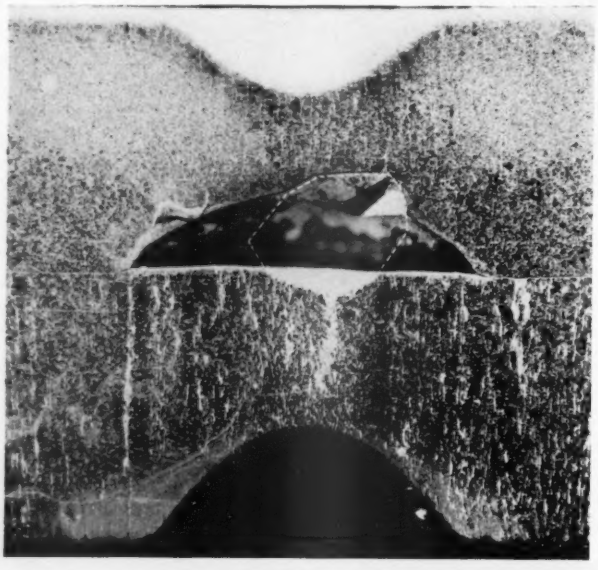

Figure 2. Defective Diamond die mounting due to poor metal flow. ✦

✦ ✦ ✦

Bell Angle

THE bell angle should permit ready ingress of the compound solution to wash out those materials (dust, slivers, sludge, dirt, etc.) which tend to accumulate here and have an abrasive action when pulled through the die by the wire. The bell angle is highly polished to minimize the packing of the noted materials. This polish can be more easily achieved in a smooth tapering angle than in one of a wide flare.

✦ ✦ ✦

Approach Angle

AT high drawing speeds, appreciable wire whip and vibration are present. Also, the centrifugal forces tend to "throw out" the wire in relation to the normal axis of the die. An approach angle not too wide in relation to the reduction angle is necessary

to guide the wire concentric to the drawing cone.

✦ ✦ ✦

Reduction Angle

IN this angle, the most important sector of the die, the reduction of diameter, except for the sizing accomplished in the bearing, is carried out. Following the practice of the trade a 16° angle is used. The depth of this area is designed to have the entering wire hit well within it to prevent excessive chipping and undercutting in the pressure ring and to maintain the desired die pull values. The line of contact of the entering wire and the reduction area is located at 65-70% of the vertical height of the reduction angle.

✦ ✦ ✦

IN general, the ratio of the vertical heights of the reduction, approach and bell angles are as follows: 1:0.7:1.5 for dies of 20-26 A.W.G. inclusive and 1:0.5:1 for the larger sizes. The dimensions of the approach and bell angles are of course dependent on the stone size and the number of previous recuts. The heights of the two latter angles may vary appreciably from the above noted values providing that adequate lubrication and "washing out" of the die can take place.

✦ ✦ ✦

Bearing

A BEARING length of about 40% diameter is formed. It is checked by the die pull requirements. The bearing is purposely drilled to obtain a slight front taper of about 2°. The slight taper aids the metal flow and reduces "sucking."

✦ ✦ ✦

Relief Angle

HERE again, the wire vibration necessitates a smooth angle which will not tear the wire leaving the die. Recutting for good reproduction of contour and die pull also requires a smooth angle. Proper care should be taken to prevent a cup shaped depression which is commonly formed by jamming a diamond chip in the back of the die as a fast intermediate step to final sizing.

Polish and Finish

THE degree of polish of the die drawing surfaces is a most important factor in determining satisfactory die performance. In wire drawing there is encountered a vicious repetitive cycle consisting of (1) the wire abrades due to the condition of the wire and die surfaces, (2) the resultant abraded metal particles pack in the die throat and gall the incoming wire, and (3) the heat and the conditions created by this action again adversely affect the wire and the die surfaces to repeat the cycle. There have been cases noticed where the fine copper particles have been compacted by the heat and pressure to form a solid conical mass which has welded to the wire. Deep grooves in the reduction angle and bearing invariably follow back to the pressure ring or irregularities in the die surfaces in which the metal particles, dirt, etc., have lodged.

✦ ✦ ✦

CHARACTERISTIC of copper and other non-ferrous metals is its ready flow under pressure such as is present in the die reduction angle. This condition causes die packing, metal galling and the resultant wire scoring to take place at surprisingly slight irregularities in the die drawing surfaces. This is particularly true at high drawing speeds due to the rapid lineal movement of the wire surfaces. Again this emphasizes the necessity for a high polish. The harder ferrous metals tend to bridge across these small irregularities rather than to flow into them.

✦ ✦ ✦

HIGHLY polished surfaces free from scores, traces of ripping rings and scratches are desired. All the die surfaces with the exception of the relief angle and top flare of the bell should be so finished. The polished surfaces should be a smooth curve as undulating surfaces are undesirable.

✦ ✦ ✦

DIES after full use to oversize will retain their original high polish if no breaks in the stone, i. e. chips, cracks, etc, have occurred. This polish will also be present in the wear eroded areas.

✦ ✦ ✦

Pounds Pull to Draw the Wire Through the Die

DIE pull has long been known to the trade as a factor which greatly influences wire drawing operations. However, it has not been customary to recognize its relation to the drawing die itself and it has not been applied as an everyday simple means of checking a die's possible performance. The **Western Electric Company** has considered for a long time this die characteristic in its wire drawing developments[4] and practical values for use in the present high speed drawing machines have been established. Listed in Table 1 are the values used for these dies. It should be added that, while die pulls are important, these are not critical and a deviation of +10% can be used but this would result in greater power consumption and more frequent wire breaks. The noted figures are 45-50% of the wire breaking strength based on A.W.G. reduction steps. Die pull is a cumulative check of the following die characteristics; contour as correlated to the reduction angle and bearing length, and the polish of the drawing surfaces. In conjunction with the die di-

TABLE I

Diamond Die Diameter	Max. Pounds Pull	Diamond Die Diameter	Max. Pounds Pull
13 A.W.G.	113	20 A.W.G.	25
14 A.W.G.	92	21 A.W.G.	21
15 A.W.G.	75	22 A.W.G.	17
16 A.W.G.	60	23 A.W.G.	13.5
17 A.W.G.	49	24 A.W.G.	11
18 A.W.G.	39.5	25 A.W.G.	9
19 A.W.G.	32	26 A.W.G.	7

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SEGMENT TYPE SPECIFICATIONS

Size	Machine No.	Wire Diam. Range: Std. Feed Gears	Wire Diam. Range: Extra Feed Gears: 1st Set	Wire Diam. Range: Extra Feed Gears: 2nd Set	Wire Length for Spring: Std. Feed Gears	Wire Length for Spring: Extra Feed Gears: 1st Set	Wire Length for Spring: Extra Feed Gears: 2nd Set	Coil Range O. D.	Production Springs per Minute: Motor Drive	Production Springs per Minute: Variable Speed Drive	Motor Req'd	Floor Space Variable Speed Drive	Net Weight Lbs. Variable Speed Drive
00	W-100	.003" to .015"	.003" to .010"	None	0" to 16"	0" to 23"	None	1/32" to 9/32"	None	50 to 350	½ H.P.	14" Face 21" Depth	405
0	W-10	.008" to .028"	.008" to .024"	.008" to .020"	0" to 24"	0" to 36"	0" to 48"	1/16" to 7/8"	42 84 130 180	40 to 240	½ H.P.	20" Face 22" Depth	425
1	W-11	.015" to .072"	.015" to .062"	.015" to .047"	0" to 42"	0" to 63"	0" to 83"	3/32" to 1 9/16"	30 55 80 120 175	23 to 190	1½ H.P.	28" Face 36" Depth	975
2	W-12	.047" to .148"	.047" to .120"	.047" to .093"	0" to 60"	0" to 91"	0" to 127"	¼" to 2¾"	27 57 75 100	7 to 120	5 H.P.	70" Face 54" Depth	4,400
2½	W-125	.080" to .207"	.080" to .162"	.080" to .125"	0" to 75"	0" to 100"	0" to 147"	3/8" to 3¾"	30 40 50 60 73 89	13 to 93	10 H.P.	84" Face 60" Depth	7,300
2½ Spec.	W-125S	.105" to .250"	.105" to .177"	.105" to .135"	0" to 75"	0" to 100"	0" to 145"	3/8" to 4¼"	30 40 50 60 73	13 to 77	10 H.P.	86" Face 60" Depth	7,900
3	W-13	.125" to .312"	.125" to .250"	.125" to .187"	0" to 60"	0" to 80"	0" to 120"	5/8" to 4 5/8"	11 28 40 55 77	None	15 H.P.	Motor Drive: 94" Face 72" Depth	11,600

Attachments Available: torsion spring coiling, ball or roller bearing wire straighteners, continuous coiling, compound gearing for slower production.

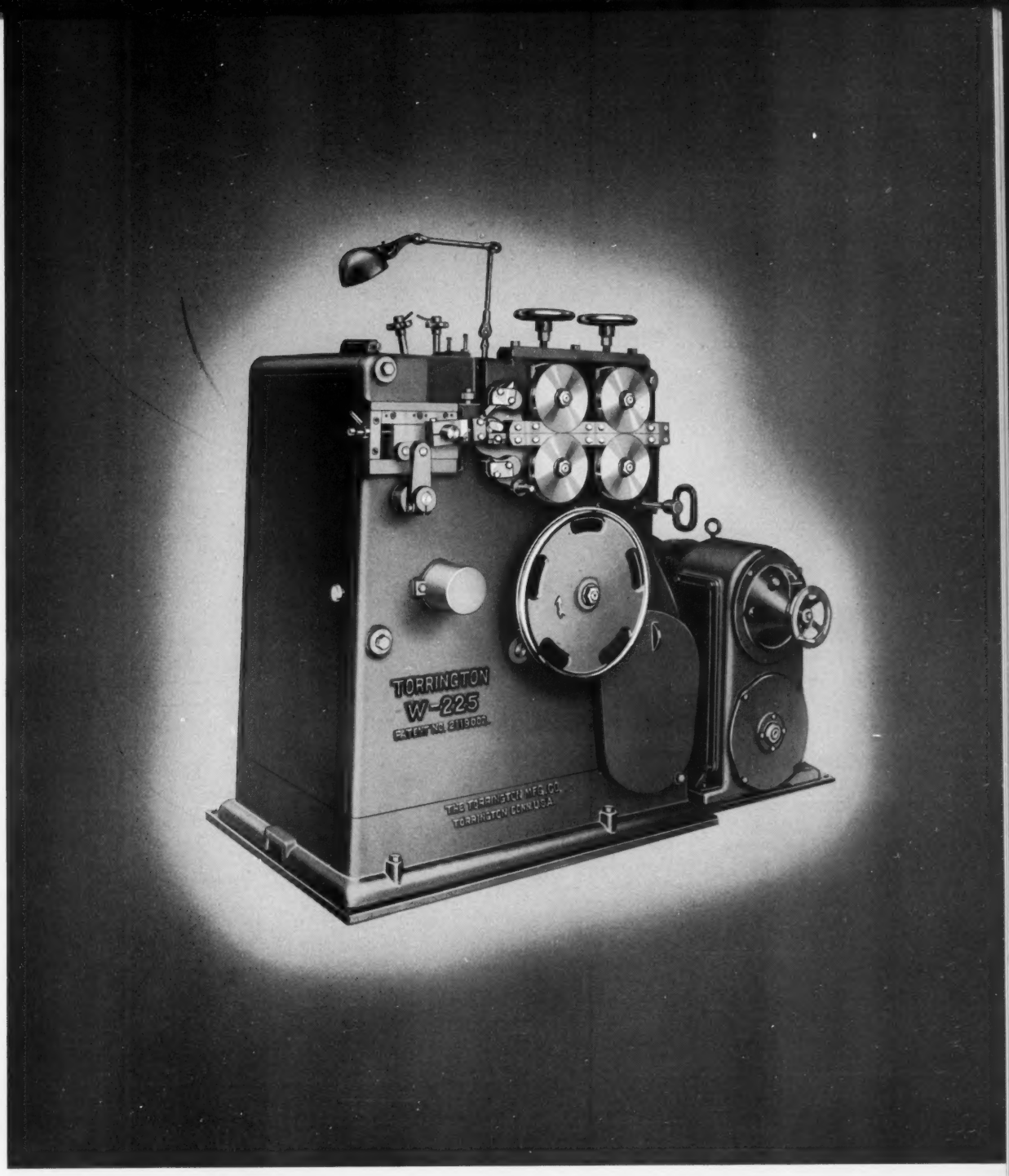
A SIZE FOR EVERY NEED

CLUTCH TYPE SPECIFICATIONS

Size	Machine No.	Wire Diam. Range	Wire Length per Spring	Coil Range O. D.	Production: Spgs. per Min. All Type Drives	Production: Feet Wire Per Min.: Motor Drive	Production: Feet Wire Per Min.: Variable Speed Drive	Motor Required	Floor Space Variable Speed Drive	Net Weight Lbs. Variable Speed Drive
0	W-20	.008" to .028"	1.4" to 665"	1/16" to 7/8"	3 to 130	48 82 129 190 252	25 to 290	½ H.P.	20" Face 22" Depth	545
1	W-21	.015" to .072"	1.1" to 600"	3/32" to 1 9/16"	3 to 110	34 86 164 258	27 to 255	1½ H.P.	28" Face 36" Depth	975
2	W-22	.047" to .148"	1.8" to 600"	¼" to 2¾"	3 to 90	47 101 156 235	48 to 243	5 H.P.	70" Face 54" Depth	4,400
2½	W-225	.080" to .207"	3" to 770"	3/8" to 3¾"	2 to 85	40 103 181 237	40 to 240	10 H.P.	84" Face 60" Depth	7,200
3	W-23	.125" to .312"	2" to 648"	¾" to 4¼"	2 to 60	42 54 94 123 215		15 H.P.	Motor Drive: 64" Face 68" Depth	8,000
4	W-24	.187" to .500"	3.6" to 815"	1" to 6"	2 to 50	42 79 118 175 328		20 H.P.	74" Face 80" Depth	13,600

Attachments Available: torsion spring coiling, ball or roller bearing wire straighteners.

TORSION SPRINGS on the same machine that makes EXTENSION and COMPRESSION Springs



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ameter, it affords a means of grouping the dies in matched balanced sets and obviates actual try out of these dies in the machines.

✦ ✦ ✦

Inspection Methods

SUITABLE inspection methods and equipment to check the die requirements contribute much to good die performance. Microscopes have been used with good results by some manufacturers of fine wires and by several of the more progressive die manufacturers for some time for this purpose. The Western Electric Company has adopted this practice. The binocular wide field microscope has proved to be an indispensable tool for inspection. It is used to the complete exclusion of loupes. The stereoscopic effect, the wide field and the long focal distance features of this instrument make satisfactory examination possible. We have found a magnification of 30X to be most practical for the previously noted die sizes. Good agreement to observations by different persons can be had by the use of this apparatus. This is a rare occurrence in the case of loupes. It is surprising that this inexpensive tool which removes much of the guessing and so-called art in diamond die manufacture has not been universally utilized by wire drawers and die manufacturers.

✦ ✦ ✦

FREQUENT examination of finished dies and dies in the various stages of recutting is expediently accomplished by microscopic observation. Routine die contour checks are visually made in this manner. Periodic checks of die angles and die contour are accurately made with a contour projector. Shadowgraphs of 100X magnification are made of die impressions formed of a soft metal.

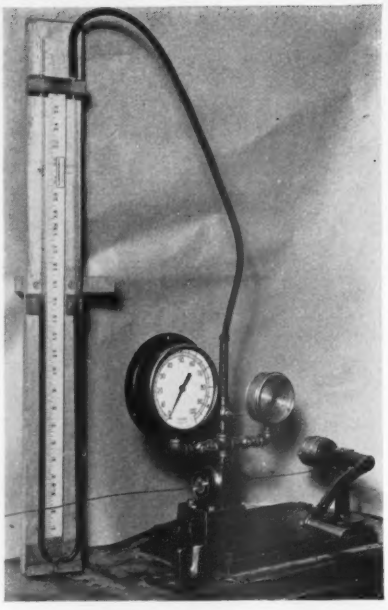


Figure 3. ✦ ✦ ✦ ✦

✦ ✦ ✦

WHEN polished to the proper degree, it is possible to examine a mounted die under a microscope with a suitable light source and discern the internal flaws in the stone. The examination of stones removed intact from the mounting will also check this point. Mountings of metals having a low reflectivity will require a light source from above to illuminate the stone.

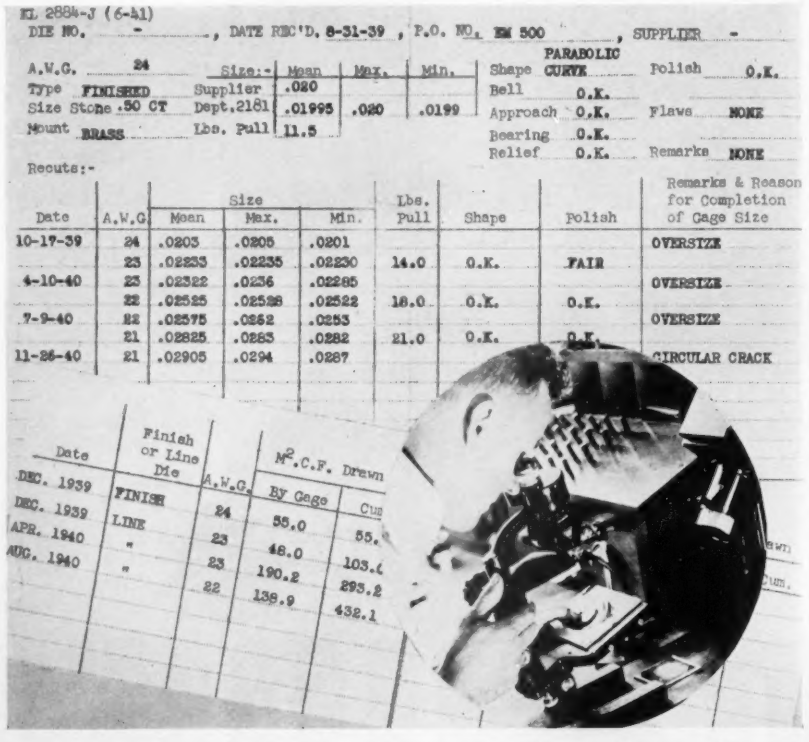
✦ ✦ ✦

THE die pull is checked on a commercial instrument shown in Figure 3. Auxiliary equipment and gauges have been added to it to make it more versatile for this use. The device consists of a piston which fits snugly into a hydraulic chamber filled with a suitable liquid. The piston is recessed at the outer end to hold the die. The die pull causes the movement of the piston which builds up the registered pressure. The wire is reduced one A.W.G. step and the pressure against the die holder is noted as indicated on the adjoining gauge. Small die sizes having die pulls below five pounds are checked by means of a manometer filled with an appropriate liquid. When measuring die pulls of low magnitude, the device should be calibrated for the frictional drag of its moving parts.

✦ ✦ ✦

Die Records

DIE control is greatly enhanced by comprehensive records. All dies are logged on individual record cards. A facsimile of each side of this card is shown in Figure 4. As noted, the individual die characteristics as received, at oversize, and after recutting to final disposition are recorded. These cards are periodically correlated to the daily machine performance sheets by mechanical tabulation to obtain the die life.



KL 2884-J (6-41)

DIE NO. - , DATE REC'D. 8-31-39 , P.O. NO. EM 500 , SUPPLIER -

A.W.G.	24	Size:-	Mean	Max.	Min.	Shape	PARABOLIC CURVE	Polish	O.K.
Type	FINISHED	Supplier	.020			Bell	O.K.		
Size Stone	.50 CT	Dept.2181	.01995	.020	.0199	Approach	O.K.	Flaws	NONE
Mount	BRASS	Lbs. Pull	11.5			Bearing	O.K.		
						Relief	O.K.	Remarks	NONE

Recuts:-

Date	A.W.G.	Size Mean	Size Max.	Size Min.	Lbs. Pull	Shape	Polish	Remarks & Reason for Completion of Gage Size
10-17-39	24	.0203	.0205	.0201				OVERSIZE
	23	.02233	.02235	.02230	14.0	O.K.	FAIR	
4-10-40	23	.02322	.0236	.02285				OVERSIZE
	22	.02525	.02528	.02522	18.0	O.K.	O.K.	
7-9-40	22	.02575	.0262	.0253				OVERSIZE
	21	.02825	.0285	.0282	21.0	O.K.	O.K.	
11-26-40	21	.02905	.0294	.0287				CIRCULAR CRACK

Date	Finish or Line Die	A.W.G.	M².C.F. Drawn By Gage	M².C.F. Drawn Cus
DEC. 1939	FINISH	24	55.0	55.
DEC. 1939	LINE	23	48.0	103.
APR. 1940	"	23	190.2	293.2
AUG. 1940	"	22	138.9	432.1

Figure 4. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

Shop Die Control

ALL drawing dies are grouped in sets for use and matched for balance in relation to their diameters. This is necessary because of the minimum slip characteristics of the drawing machines. It is also a convenient means to reduce machine down time. The sets are used in the drawing machines as units. Replacements and rematchings are made in the Die Shop. Definite oversize diameter limits consistent with best enlargement practice and overall operating efficiency have been set for each finisher and line die size. The die sets are removed from the machine when any one die, with the exception of the finisher, has reached the specified limit. Usually two finishers are used for each set of 26 A.W.G. and one plus for the other final gauge sets before returning these units to the Die Shop. This procedure has greatly enhanced the economics of die costs, operating efficiency and wire quality. It has also made possible the issuance of dies by the Die Shop for shop use without the necessity for preliminary "try-out" in the drawing machines.

✦ ✦ ✦

Recutting Practice

DIAMOND die recutting is a series of lapping operations in which the abrasive is diamond dust for obvious reasons and the lap or carrier is a suitable pin or wire, usually steel, depending upon the specific operation. The theory and practice of lapping tool gauges to a fine finish is applicable here. The diamond dust imbeds in the lap, is held there temporarily stationary and cuts the die stone when it is forced in contact with it. As its position is fixed relative to the lap, but moving with respect to the stone, it cuts the die surface. However, due to the great hardness of diamond, appreciable wear of the lap takes place and its shape is rapidly changed. In ripping where the shaping of the die contour is done, the pin must be frequently reground. It is necessary to have a hard material for the lap to keep the diamond dust working in contact with the die surface and to retain its shape for an appreciable time. Also, some diamond dust would imbed deeply in a soft material and be removed in the grind.

✦ ✦ ✦

SUCCESSFUL recutting and reproduction of die characteristics requires definite procedures and controls. Specific hole size enlargement, surface requirements, frequency of lapping pin grinds, diamond dust additions, etc., are essential for each operation to achieve the desired results.

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STANDARD commercial machines are used for the various enlarging and refinishing operations. In general, recommended trade practices are followed.

✦ ✦ ✦

RIPPING, the roughing operation which removes the pressure rings, chips, etc., and reshapes the die contour is most important as it determines the die contour and the subsequent degree of polish. We have found the RPM of the drilling pin spindles to be a determining factor. Spindle RPM's from 4,000 to 12,000 have been tried, and 5,000 RPM has been found to be most satisfactory. Other important elements are the diamond dust size, frequency of pin grinds, speed and kick of the reciprocating vertical motion. A definite sequence of these factors is necessary to achieve the desired results. A gradual breakdown of the diamond dust effecting a cutting and lapping action as controlled by the centrifugal forces dispersing it in the liquid medium takes place. The steel lapping pins are accurately ground to a definite straight included angle and circular arc on a special grinder. The ripped die surface should be a smooth, dull matte surface free of deep rings and scores.

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IN polishing, the die contour has already been established and it is expedient to have the lap of a material which will rapidly shape itself to the contour to be polished to obtain maximum contact. Here the loading of the lap will hold the diamond dust in contact with the work. A viscous medium for the dust will also help. On the wire polishing machines, the springback of the wire on flexing is important. It was found that a wire resiliency tester will aid to evaluate the desired wire properties. Diamond dust of a uniform and fine grain size is vital to the polishing operation. High RPM in the case of revolving die mounts is beneficial providing that it does not "throw out" the diamond dust from the working area.

✦ ✦ ✦

SIZING of the bearing requires a spindle RPM about 100% higher than that used in ripping. Other factors in this operation are the diamond dust, frequency of its addition and the frequency of the pin grinds.

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ALL die recutting machines should be periodically checked and maintained to minimize vibration.

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Diamond Dust

ANOTHER important factor in the recutting operations is the diamond dust abrasive. This is especially true in the finishing operations of polishing and sizing where no appreciable breakdown of the original dust takes place. Uniformity of particle size range and grain size determine the efficacy of the abrasive. Diamond dust graded by air flotation is now being used with good results. It was found that this material was more satisfactory for our use than that obtained by sedimentation in liquid media. Recent investigations in the separation of microscopic size dry powdered materials have been actively carried out in the ceramics and powdered metal industries. The **Journal of the American Ceramic Society** and the **Bureau of Mines** publications contain noteworthy papers describing practices which could be applicable to diamond dust grading. **Stokes**[5] law of fall for microscopic size particles will also hold true for the separation of diamond dust by means of air.

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Die Life

IN theory and practice, die life resolves itself into a problem

of wear. The wear is due to the movement of the wire surface over the drawing die area in contact with the wire. In turn the wear is proportional to the forces acting on these surfaces, their area, the condition of these surfaces and the coefficient of friction. This is dependent on the nature of the wire, the die materials and the lubrication of the contacting surfaces which in turn is affected by their condition. Considered on this general basis, the die life is proportional to the wire lineal footage. A good criteria for determining the overall diamond die performance is the total useful life in million conductor feet. This in turn will be proportional to the number of recuts obtainable before breakage renders the die non-usable.

TABLE II

Kearny Wire Mill 1/39 - 8/40

B&S	Finishers		Line Dies		Average*	
Ga.	M Lbs.	M.²C.F.	M Lbs.	M.²C.F.	M Lbs.	M.²C.F.
26	35	45	..	..	35	45
25	..	..	90	93	90	93
24	92	75	105	86	97	79
23	..	..	162	108	162	108
22	136	70	159	82	148	76
21	..	..	226	92	226	92
20	..	..	250	81	250	81
19	250	64	284	73	277	71
18	..	..	368	75	368	75
17	..	..	595	96	595	96
16	..	..	740	95	740	95
15	..	..	1040	106	1040	106

*Based on Kearny's distribution of gauges

Average M.²C.F. per die gauge step 85

NOTE: Some of the results listed above appear to be inconsistent with the expected trends. This is attributed to the many variables which exist in normal Wire Mill Operations.

✦ ✦ ✦

ALTHOUGH diamond die life is theoretically a function of wear, actually it is limited by the failure of the die stone by breakage and "chipping out." Due to the peculiar physical properties of diamonds some breakage will always occur. This condition is also affected by fatigue caused by vibration, impact, thermal stresses and other factors. An important element influencing die breakage which is often overlooked is the detrimental effect produced by improper maintenance of the drawing machine parts. An appreciable reduction in die breakage was obtained by proper periodic maintenance checks.

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Kearny's Wire Mill diamond die life data are listed in million conductor feet per die per gauge step in Table II. The finisher and line die life is tabulated separately to account for the allowable oversize diameter limits for each type. No data are available at the present time to permit listing of the total useful life in million conductor feet.

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Strains in Diamond Stones

ROUGH diamond stones as well as those removed after use in drawing dies have been examined in polarized light to determine the presence of internal strains. In general, the clear flawless stones of alluvial origin were free of strains. Mined stones of South African origin which are commonly found in dies of French manufacture did show in several cases very definite strains. These latter stones were of poor quality. Due to the high index of refraction of the diamond which is much higher than available high refractive liquids, and to local surface strains which distort the interference figures, it was impractical to establish a satisfactory procedure to investigate this subject.

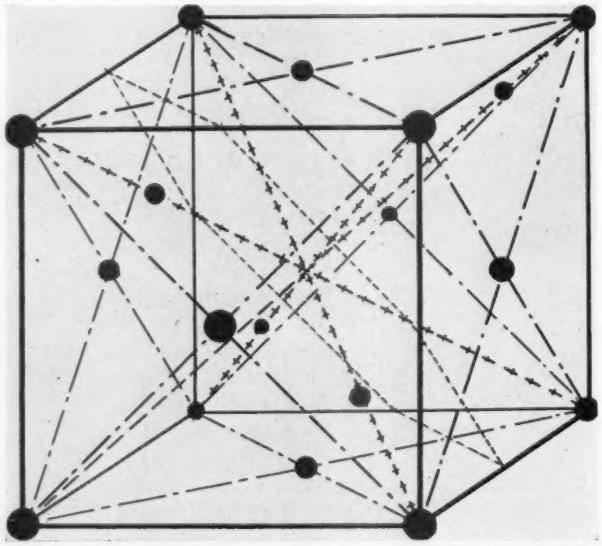

Figure 5. Diamond Structure
● Carbon Atoms
+ + + (111) Directions
- — - — (110)
——— (100)
- - - - - - Cleavage Plane (one of four)

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Crystallographic Studies

IN several cases, exceptional die performance was noted, three to four times the average, which could not be accounted for by our regular inspection methods. Also, several dies which chipped initially in use, consistently chipped at subsequent recut sizes after enlargement had completely removed the visible defect. Again and most important is that the majority of our dies are rendered non-usable by the breakage of the die stone, which occurs in a characteristically peculiar manner. These discrepancies are attributed to the crystallographic structure of diamonds. It is well known that the reticular density (atom spacing), hardness and cleavage are greater along certain crystallographic planes.

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INVESTIGATIONS as to whether or not the relation of the planes

of cleavage to the direction in which the hole is drilled has any practical bearing on die life were made by the **Western Electric Company** in 1929[4]. The x-ray was used to determine the orientation of the crystal planes. The results of a limited test at that date, in which nineteen dies were drilled at right angles and nine parallel to the plane of cleavage, showed no superiority of these positions. The diamond stones used for dies then were of different origin and quality than those now commonly employed for this purpose. Further studies, with particular reference to the relation of crystal structure to die breakage, are now under way for reasons noted previously, and some of our results to date are cited here having a bearing on die performance.

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IT is well known that hardness in a diamond varies with the crystal planes. However, since the contour of the die hole consists of cylindrical and conical surfaces, it is questionable if this plane property could be effectively utilized in drawing dies.

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AN x-ray method[6] on a shop production basis is now being used to orient quartz plates preparatory to their cutting along certain crystallographic planes incident to their manufacture into radio and carrier frequency control filters. A similar technique was applied to determine the location of the axis of the die drawing hole with relation to the diamond structure. The orientation of the drilled hole was determined by means of a back reflection **Laue** photograph.

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DIAMOND stones which meet our drawing requirements are mostly octahedral in shape, a common crystal form of this material. These are usually alluvial in character and predominantly of Brazilian origin with the exception of a few Southwest African stones.

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OUR examinations of numerous die stones has shown that the positioning of these is random with regard to a predetermined drilling axis. About 75% of those studied were drilled normal to the 111 orientation. The axis of the drawing hole in these cases was in the direction of a body diagonal of the cube representing the crystal structure of the diamond. The 111 planes, the cleavage planes for the diamond, are those which appear most frequently as the natural faces of the most common form of the diamond crystal, the octahedron. The disposition of the stone in the above manner would be logically expected to take place in the mounting methods generally used by the American die manufacturers since the stone would probably rest on a flat side, an octahedral face. This placement for very obvious reasons also facilitates cutting true the starting cone for the drilling operations.

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A FEW stones had been drilled normal to the 110 and 100 planes or at an angle to the 111 plane. Holes normal to the 110 plane, which is the face of the rhombic dodecahedron, another diamond crystal form, are along a face diagonal of the cube. Holes normal to the 100 plane, which is the cube face, are along a cube edge. Very few of these were found. This is as expected since natural crystals with faces parallel to the 100 plane are rare. This face is usually produced by sawing or "bruting."

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AS previously noted, diamond die life is restricted by the breakage and "chipping out" of the stone. The manufacture of the dies with due consideration of the peculiar crystallographic structure of the diamond to minimize this condition should greatly enhance its performance. Findings to date substantiate this conclusion. Seventy per cent of the dies which were drilled normal or at a small angle to the 111 plane failed due to cracks parallel to this plane and normal to the drawing axis. The crack usually occurred at the pressure ring and its plane coincided with the cleavage plane, the weakest one in the diamond crystal. The stone in many cases on removal from the metal mounting separated into two sections. The majority of the dies failed in this manner.

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EXAMINATION of worn oversize dies invariably shows that the erosion and the effect of the forces incident to wire drawing are concentrated at the pressure ring where the entering wire contacts the reduction area. Here, the abrasive action of the wire and die contacting surfaces, and the disrupting stresses are most evident. An analysis of the forces present in a wire drawing die indicates that secondary stresses normal to the drawing axis are set up in this sector. In dies drilled normal to the 111 plane these stresses, coupled with the thermal, impact and fatigue forces converging in this area, would tend to shear the diamond stone parallel to this plane. Overdrawing and poor operating conditions would of course accentuate this effect and bring it about prematurely.

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THE previously mentioned dies drilled normal to 110 and 100 planes did not crack in the manner noted above. These failed due to chipping and spalling. Cracks, when present, were small and inclined to the drawing axis. Dies drilled normal to 110 plane have cleavage planes parallel to the die hole axis. In one case a stone drilled in this manner cracked along this plane. Data to date indicate that better die life was obtained from these dies than from those drilled normal to the 111 plane.

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THE noted studies indicate that the orientation of the drawing hole is of practical significant importance with regard to stone breakage, the limiting factor of die life. A better understanding of its relation to die performance should achieve appreciable economies. No conclusions have been made as yet with regard to the exact desired orientation of the drawing axis. In Figure 5 is de-

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picted a unit cube of a diamond structure. Here is shown the possible directions of drilling and the location of the cleavage plane. Figure 6 shows the diamond crystal faces and planes.

✦ ✦ ✦

WHETHER or not the aforementioned die breakage characteristics are local to our drawing operations and die sizes is not known. We invite comments from other wire manufacturers whose equipment and practices vary significantly from those used at the Kearny Wire Mill.

✦ ✦ ✦

Acknowledgment

The author wishes to acknowledge and thank Mr. F. E. Haworth, of the Bell Laboratories, for his x-ray determinations and Mr. W. W. Broughton, of the Quartz Crystal Development Group of this Company, for his many suggestions with reference to the crystallographic studies.

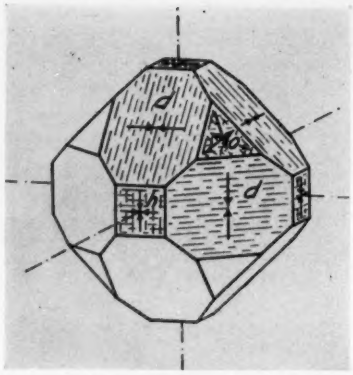

Figure 6a. Diamond Crystal Showing grain and faces (crystallographic planes). ✦
h. Cube face 100 plane
d. Rhombic dodecahedron 110 plane
o. Octahedron 111 plane

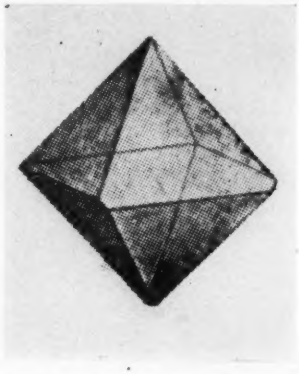

Figure 6b. Diamond Octahedron. ✦

REFERENCES

1. Design and Operation of a New Copper Wire Drawing Plant by H. Blount and J. E. Wiltrakis, Wire and Wire Products, October 1940.
   Bell Telephone System Technical Publications Monograph B-1273.
2. Developments in the Manufacture of Copper Wire by J. R. Shea and S. McMullan, Western Electric Company, Inc.
   Journal of the American Institute of Electrical Engineers, Vol. XLVI, February 1927.
   Bell System Technical Journal, Vol. VI, April 1927.
3. Stresses in Wire Drawing (Digest of research work conducted at Sheffield University, England) by A. C. Blackall, Wire and Wire Products, August 1933.
   Fundamentals of Wire Drawing by F. C. Thompson, Victoria University of Manchester, England, The Iron Age, October 13, 1938.
4. Development of Wire Drawing Methods by J. R. Shea, Western Electric Company, Inc. Part three of papers presented at the Hawthorne Works of the Western Electric Company, Inc., Chicago, Illinois, July 10-12, 1929, to the Summer School for Engineering Teachers sponsored by the Society for the Promotion of Engineering Education.
5. A quantitative physical law governing the fall of small particles in various media due to gravity. Handbook of Chemistry and Physics, p. 2224, 24th Edition 1940-41.
6. Manufacture of Quartz Crystal Filters by G. K. Burns, Western Electric Company, Inc.
   Bell Telephone System Technical Publications Monograph B-1253.
7. Variation of Hardness in the Diamond by E. H. Kraus and C. B. Slawson, University of Michigan, The American Minerologist, November 1939.

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THE Eleventh Annual Convention of the Wire Association will be held at Philadelphia, Pa., October 20-24, 1941 in association with the National Metal Congress.

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YOUR attention is called particularly to the Wire Association "National Unity and National Defense Luncheon" which will have speakers from Industry, The Army, The Navy and The Government who will deliver interesting addresses.

THIS program is for your information and we extend a cordial invitation to you to be present at the meetings this year.

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THE Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, and all others engaged in the production of cold drawn bars, rods, wire, strip, insulated wire and cable, and the manufacture and fabrication of finished wire products, including cold headed, extruded and other cold worked metal products.

THERE are separate divisions for all the separate major interests in the wire industry, steel, iron, brass, copper, alloy, and precious metals, together with divisions relating to drawing, cold working, cold heading, extruding, fabricating, forming, spring making, wire cloth, wire rope, bare and covered electric wire and cable and all other forms of wire and wire products.

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PURPOSES

ITS specific purpose is to improve production methods and afford a clearing house for ideas on management problems, technical problems, and research work in all phases of practical wire drawing and wire working, and to develop and maintain friendly relations among the members.

✦ ✦ ✦

ACTIVITIES:

The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Standardization and simplification as a means for the effective elimination of waste.
8. Such other subjects as may be determined upon.

❖ PROGRAM ❖

Wire Association Convention---1941

Philadelphia, Pa., October 20-24, 1941. Association Headquarters — Hotel Philadelphian

✦ ✦ ✦

The Exposition and Show of the National Metal Congress Will Be Open from Monday to Friday Inclusive, All Day and Every Evening During the Week Except Thursday Evening.

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The Technical Sessions End Thursday in Order that Friday May Be Available To Make A Thorough Inspection of the National Metal Exposition.

MONDAY, OCTOBER 20

10:30 A. M.
DIRECTORS' MEETING

12 NOON
PROGRAM COMMITTEE LUNCH

Registration and Information. (Mezzanine of Hotel Philadelphian) — October 20-24 — in charge of Mrs. R. S. Spengel, Secy.-Treas., WIRE & WIRE PRODUCTS.

--- The Technical Sessions ---

ALL RESEARCH PAPERS ARE PREPRINTED IN THE OCTOBER ISSUE OF WIRE AND WIRE PRODUCTS

The Discussions and the Mordica Memorial Lecture Will Be Printed in the January, 1942 Issue of Wire and Wire Products

MONDAY, OCTOBER 20

Afternoon Session — 2:30 P. M.

Sidney Rolle, Assistant Manager, Scomet Engineering Co., New York, N. Y.
Chairman of Meeting

OPENING ADDRESS	F. A. Westphal, Superintendent, Wire Mills, Past President, The Wire Association	Sheffield Steel Corp., Kansas City, Mo.
PAPER: "The Cable Industry in National Defense"	By Kenneth S. Wyatt, Cable Engineer	Phelps Dodge Copper Products Corp., New York, N. Y.
SOUND MOTION PICTURE: "Wings of the Army"	The History and Activities of The U. S. Army Air Corps	Supplied by the Air Corps, U. S. Army

TUESDAY, OCTOBER 21

Morning Session — 9:30 A. M.

J. K. Beeson, Vice President, Pittsburgh Steel Co., Pittsburgh, Pa.
President of The Wire Association
Chairman of Meeting

THE MORDICA MEMORIAL LECTURE

To Be Presented By
Kenneth B. Lewis,
Consulting Wire Mill Engineer,
Worcester, Mass.

"The Shape of Things To Come"

SOUND MOTION PICTURE: "Steel for the Ages"	Allegheny Ludlum Steel Corp.	Pittsburgh, Pa.

TUESDAY, OCTOBER 21

1:00 P. M.

WIRE ASSOCIATION ANNUAL LUNCHEON — HOTEL PHILADELPHIAN
— "NATIONAL UNITY AND NATIONAL DEFENSE" —

Speakers

Industry:	Dr. Allan A. Stockdale,	National Association of Manufacturers
Navy:	Rear Admiral Wat Tyler Cluverius, U. S. N., (Ret.)	President, Worcester Polytechnic Institute, Worcester, Mass.
Army:	Brig. General J. W. N. Schulz, Director of Purchases and Contracts Office of the Under Secretary of War	War Department, Washington, D. C.
Government:	Dr. Chas. I. Gragg, Associate Professor of Marketing, Harvard Graduate School of Business Administration. Chief Consultant to Executive Director of Supply Priorities and Allocations Board and to the Director of the Priorities Division of the Office of Production Management.	Office of Production Management Washington, D. C.

(Members are at liberty to bring guests to hear these interesting speakers. Ladies are welcome and members and guests of other societies participating in the National Metal Congress are also invited to attend.)

Brigadier General John W. N. Schulz

United States Army.
Director of Purchases and Contracts,
Office of the Under Secretary of War,
Washington, D. C.

Photo by U. S. Army Signal Corps.

GENERAL SCHULZ was born in Wheeling, West Virginia, on May 14, 1885. He was appointed to the Military Academy from his native State on June 16, 1904, and upon graduation, February 14, 1908, was commissioned a second lieutenant of Engineers.

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IN February, 1911, he became a first lieutenant; a captain in February, 1915, with temporary promotions in rank up to and including August, 1918, when he was promoted to colonel (temporary). He reverted to the permanent grade of major on August 31, 1919, after which he received promotions in rank up to January 29, 1941, when he became a brigadier general (temporary).

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UPON joining the 3rd Battalion of Engineers in May, 1908, General Schulz was stationed at Fort Leavenworth, Kansas, serving until August, 1909, when he was ordered to Washington, D. C. While in Washington he attended the Engineers School and upon graduation rejoined the 3rd Battalion. During his term with this division he accompanied the group to the Philippines where he remained until November, 1914. Returning to the United States he served as Assistant to the District Engineer and later as District Engineer, Yellowstone National Park.

✦ ✦ ✦

GENERAL SCHULZ went to France in 1917, serving in the Office of Chief of Gas Service, A. E. F., in Chaumont and Tours and on temporary duty with Chief, Chemical Warfare Service, A. E. F., until June, 1919. While serving in France, General Schulz participated in the Oise-Aisne, St. Mihiel and Meuse-Argonne offensives, and was awarded the Order of the Crown of Italy (Cavaliers). He returned to the United States in July, 1919, and was assigned to duty as Instructor in Engineering and Chemical Warfare at the Army Service Schools, Fort Leavenworth, Kansas, until July, 1923, during which time he was graduated from the General Staff School. He then entered the Army War College, Washington, from which he was graduated on July 1, 1924, and after serving on temporary duty at Camp Meade, Maryland, with the 13th Engineers to August, 1924, he was ordered to San Francisco, California, where he was on duty as District Engineer, 1st District, to August, 1927. He then served with the 6th Engineers at Fort Lewis, Washington, to August, 1929, when he was transferred to Chicago, Illinois. He was Assistant Chief of Staff for Military Intelligence, Headquarters Sixth Corps Area, to March 7, 1933, during part of which time he was Acting Corps Area Engineer Officer. During the Century of Progress International Exposition he was Personal Representative of the Commanding General, Sixth Corps Area, and on September 15, 1933, was ordered to New York City, where he served as Assistant to the Division Engineer, North Atlantic Division, to February 7, 1935, and as District Engineer, 1st New York District, to July 16, 1936. He then attended the Army Industrial College, Washington, to June 22, 1937, and after graduation was assigned to duty in the Office of the Assistant Secretary of War, Washington, as Director of Current Procurement. On July 11, 1940, he was designated Director of Purchases and Contracts, office of the Assistant Secretary of War and on January 31, 1941, was designated Director of Purchases and Contracts in the office of the Under Secretary of War, Washington, D. C.

✦ ✦ ✦

GENERAL SCHULZ was awarded the Distinguished Service Medal with the following citation:

"As representative of the Chemical Warfare Service at General Headquarters he rendered valuable services in the solution of many important problems relating to the offensive use of gas and also in planning more effective methods for the issue of equipment and for training in gas warfare. Later, as chief gas officer of the 1st Army, he was charged with the entire responsibility of the gas warfare in that army during the St. Mihiel and Meuse-Argonne offensives. By great ability and untiring energy, his efforts resulted in the prevention of large numbers of casualties and fatalities from enemy gases as well as increasing the use of gas against the enemy, thereby contributing to the success of the American arms."

TUESDAY, OCTOBER 21 4:00 P. M.	Annual Meeting of The Wire Association — The Medal Award —	J. Kenneth Beeson, President, The Wire Association Presiding
WEDNESDAY, OCTOBER 22 Morning Session — 9:45 A. M.	A. M. Reeder, Metallurgical Engineer, Jones & Laughlin Steel Corp., Pittsburgh, Pa. Chairman of Meeting	
PAPER: "The Effects of Microstructure on the Galvanizing Characteristics of Steel"	By Robert W. Sandelin, Metallurgist	Atlantic Steel Company, Atlanta, Georgia
PAPER: "High Speed Rotary Knitting Machine for Covering Electrical Conductors"	By S. E. Brillhart, Technical Staff	Point Breeze Works, Western Electric Co., Baltimore, Md.
PAPER: "A Brief Discussion on the Manufacture of Steel for Arc Welding Electrodes"	By C. W. Garrett, Wire Mill Metallurgist	Aliquippa Works, Jones & Laughlin Steel Corp., Aliquippa, Pa.
WEDNESDAY, OCTOBER 22 Afternoon Session — 2:00 P. M.	Dr. S. A. Braley, Chief Metallurgical Field Engr., Pittsburgh Steel Co., Pittsburgh, Pa. Chairman of Meeting	
PAPER: "Stainless Wire for the Aircraft Industry"	By J. K. Findley, Metallurgist	Allegheny-Ludlum Steel Corp., Dunkirk, N. Y.
PAPER: "Diamond Dies for the High Speed Drawing of Copper Wire"	By H. N. Padowicz, Engineer	Western Electric Co., Kearny, N. J.
PAPER: "Electrolytic Zinc Coated Wire"	By L. H. Winkler, Metallurgical Engineer	Bethlehem Steel Co., Bethlehem, Pa.
WEDNESDAY, OCTOBER 22 Evening — 7:30 P. M.	ANNUAL DINNER — STAG SMOKER — THE HOTEL PHILADELPHIAN	
THURSDAY, OCTOBER 23 Morning Session — 9:45 A. M.	C. H. Hannon, Metallurgist General Electric Company, Pittsfield, Mass. Chairman of Meeting	
PAPER: "Time, Temperature and Size in the Heating of Steel Wire"	By R. R. Tatnall, Metallurgist	Wickwire Spencer Steel Co., Worcester, Mass.
PAPER: "Production of Commercial Bronze Screen Cloth Wire"	By B. H. McGar, Assistant Director of Research	Chase Brass & Copper Co., Inc., Waterbury, Conn.
SOUND MOTION PICTURE: "Wings of the Army"	The History and Activities of The U. S. Army Air Corps	Supplied by the Air Corps, U. S. Army
(This film is presented again for those who were unable to be present at the showing on Monday)		
THURSDAY, OCTOBER 23 Afternoon Session — 1:30 P. M.	Visit To National Metal Congress and Exposition.	
THURSDAY EVENING OCTOBER 23 — 7:00 P. M.	AMERICAN SOCIETY FOR METALS DINNER — HOTEL BENJAMIN FRANKLIN (Tickets for this dinner may be obtained at The Wire Association Registration Desk)	

REAR ADMIRAL WAT T. CLUVERIS

United States Navy, Retired

REAR ADMIRAL CLUVERIUS was born in New Orleans, Louisiana, December 25, 1874, and was appointed to the Naval Academy in 1892. He was serving as a naval cadet in the battleship MAINE when she was sunk in Havana Harbor, February 15, 1898, and served throughout the Spanish American War in various ships in Cuban waters. Later he served in the second USS MAINE which was built to replace the battleship destroyed. He participated in the Philippine Campaign, 1899, and commanded the NORTH DAKOTA's Battalion at Vera Cruz, in 1914.

✦ ✦ ✦

FOR his services during the World War, as commanding officer of the USS SHAWMUT, engaged in laying mines in the North Sea, he was awarded the Distinguished Service Medal. From 1919 to 1921, he served as Commandant of Midshipmen, U. S. Naval Academy, and then went to the Naval War College for instruction, graduating in 1922, when he was ordered as Chief of Staff, Commanding Fleet Base Force. In 1923, following a cruise as commanding officer of the USS SEATTLE, he went to duty in the office of Naval Operations, Navy Department.

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FROM 1926 to 1928, he commanded the USS WEST VIRGINIA. In 1928 he was promoted to Rear Admiral and served as Commandant of the Navy Yard, Norfolk, Virginia, from 1928 to May, 1930. In June, 1930 he assumed command of Battleship Division Two, Scouting Fleet and in November of the same year was appointed Chief of Staff of the Commander-in-Chief, U. S. Fleet. He served as the Commandant, Ninth Naval District, Great Lakes, Illinois, from September, 1932 to March 26, 1935 and was Commander Base Force, U. S. Fleet, from March 30, 1935 until June, 1937 when he was appointed Commandant, 4th Naval District and of Philadelphia Navy Yard.

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HE was detached from that duty and has been on leave since November 15, 1938, and was transferred to the Retired list of the Navy, January 1, 1939. He is now President, Worcester (Mass.) Polytechnic Institute.

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REAR ADMIRAL CLUVERIUS was awarded the decoration of Officer of the Order of Leopold by the Belgian Government; of Grand Officer, Crown of Italy, Commander, Order of St. Olaf, Norway, and Officer, Legion of Honor, France.

✦ ✦ ✦

HE has received the following service medals:

West Indian Campaign — 1898
Philippine Campaign — 1899
Mexican Service
Victory Medal — Mine Laying Clasp

✦ ✦ ✦

HE was in command of the United States Naval Escort for the French Cruisers, Yorktown Sesquicentennial 1931, and was the Navy's representative at the Century of Progress, Chicago, 1933-1934.

ANNUAL MEDAL AWARD of the WIRE ASSOCIATION

FOR THE MOST MERITORIOUS PAPER ON WIRE MANUFACTURE OR FABRICATION DURING THE YEAR

— BY A MEMBER OF THE WIRE ASSOCIATION —

✦ ✦ ✦

ALL members of the Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association Convention.

✦ ✦ ✦

AN annual medal will be awarded in each of the two major divisions of the activities of the Association, to the papers coming nearest to the requirement set forth above.

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CONSIDERATION for the Medal Awards is not limited to the papers presented at the Annual Meeting, but is given to all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the year.

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ADDITIONAL information may be obtained by addressing:

✦ ✦ ✦

SELECTION of papers to be presented at the Annual Convention rests in the hands of the Joint Programme Committee and the Board of Directors of the Wire Association.

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ALL papers submitted become the property of the Wire Association and the Board of Directors constitutes the Committee on Awards.

✦ ✦ ✦

RICHARD E. BROWN,

SECRETARY, THE WIRE ASSOCIATION

STAMFORD TRUST CO. BLDG. STAMFORD, CONNECTICUT

IT'S THE OFFICIAL HEADQUARTERS

The Wire Association

OCTOBER
20 to 24, 1941

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Notes on the Wire Association Program

THE papers by **Mr. Wyatt** and **Mr. Winkler** will not be preprinted but will appear in the November issue following the Meeting. The **Mordica Memorial Lecture** to be delivered this year by **Kenneth B. Lewis** will be published in the January 1942 issue of WIRE & WIRE PRODUCTS together with the discussions and minutes of the technical meetings.

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THE paper by **Kenneth Wyatt, Cable Engineer, Phelps Dodge Copper Products Corp.**, entitled **"The Cable Industry in National Defense"** will be most interesting as **Mr. Wyatt** not only outlines what the industry has done to help build the nation's armament program, but also will show in his presentation various types of wire and the methods of production followed to meet specialized government requirements.

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THE paper by **L. H. Winkler, Metallurgical Engineer, Bethlehem Steel Company**, on **"Electrolytic Zinc Coated Wire"** was not ready for preprinting because of some uncompleted experiments to be included. It will, however, be presented at the Wednesday afternoon session and then be published in the November 1941 issue of WIRE & WIRE PRODUCTS immediately following the meeting.

✦ ✦ ✦

TWO motion pictures will be shown this year; one, **"Steel For The Ages"** is a full color sound picture taking about forty minutes to show and gives a most interesting pictorial representation of the production of special types of alloy steel developed by the **Allegheny-Ludlum Steel Corp.**

✦ ✦ ✦

THE other film has been furnished by the **United States Army Air Corps** and is entitled **"Wings of the Army."** This picture is a pictorial representation of the history and activities of the Army Air Corps from the time of its organization to the present day. It is divided into four sections with complete descriptions of design, production processes, and flight, and training operations.

THE WIRE ASSOCIATION ANNUAL MEDAL AWARDS

For the Most Meritorious Paper on Wire Manufacture or Fabrication During the Year

1934 — EDWARD J. P. FISHER
Metallurgist, Keystone Steel & Wire Co., Peoria, Ill.
Title of Paper: "COLD DRAWN STEEL SPRING WIRE"

1935 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "GRAIN SIZE AND ITS INFLUENCE ON THE MANUFACTURE OF STEEL WIRE"

1936 — ROBERT NOTVEST
Chief Engineer, Welding Division, J. D. Adams Mfg. Co., Indianapolis, Ind.
Title of Paper: "STEEL FOR ARC WELDING ELECTRODES"

1937 — BENJAMIN LEWIS McCARTHY
Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "ABNORMAL GRAIN GROWTH AND THE ANNEALING OF LOW CARBON STEEL WIRE"

1938 — WALTER R. BLOXDORF
Metallurgist, The MacWhyte Co., Kenosha, Wis.
Title of Paper: "WIRE ROPE"

1939 — STANLEY P. WATKINS
Manager, Sales Development, Rustless Iron and Steel Corp., Baltimore, Md.
Title of Paper: "THE MANUFACTURE AND USE OF STAINLESS STEEL WIRE"

1940 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Company, Atlanta, Georgia
Title of Paper: "GALVANIZING CHARACTERISTICS OF DIFFERENT TYPES OF STEEL"

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HONORABLE MENTIONS

1935 — L. D. SEYMOUR
Metallurgist, Rod and Wire Dept., Youngstown Sheet & Tube Co., Youngstown, O.
Title of Paper: "COLD HEADING WIRE"

R. A. SCHATZEL
Superintendent, General Research Laboratories, General Cable Corp., Rome, N. Y.
Title of Paper: "HARD AND SOFT COPPER WIRE"

1936 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: PLASTIC DEFORMATION IN WIRE DRAWING"

1937 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Co., Atlanta Ga.
Title of Paper: "A METALLURGICAL STUDY OF THE FACTORS AFFECTING THE QUALITY OF GALVANIZING"

ALLAN B. DOVE
Chemical Engineer, Canada Works,
The Steel Company of Canada, Ltd., Hamilton, Ont., Canada.
Title of Paper: "A. C. ELECTRO PICKLING—A BETTER METHOD OF PICKLING"

1938 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Wickwire Spencer Steel Co., Worcester, Mass.
Title of Paper: "RESILIENCE OF SPRINGS"

JOSEPH A. DOYLE
Vice President, W. S. Rockwell Co., New York, N. Y.
Title of Paper: "HEATING COPPER WIRE BARS"

1940 — H. BLOUNT and J. D. WILTRAKIS
Mfg. Engineer, Point Breeze Works, Engineer, Kearny Works, Western Electric Company
Title of Paper: "DESIGN AND OPERATION OF A NEW COPPER WIRE DRAWING PLANT"

STATISTICS --- JULY, 1941

PRODUCTION FOR SALE OF IRON AND STEEL PRODUCTS

AMERICAN IRON AND STEEL INSTITUTE
Capacity and Production for Sale of Iron and Steel Products

July - 1941

		Number of companies	Item	Annual Capacity Net tons	Production for Sale—Net Tons: Current Month: Total	Current Month: Per cent of capacity	Current Month: Shipments: Export	Current Month: Shipments: To members of the industry for conversion into further finished products	Year to Date: Total	Year to Date: Per Cent of capacity	Year to Date: Shipments: Export	Year to Date: Shipments: To members of the industry for conversion into further finished products
Steel Products	Ingots, blooms, billets, slabs, sheet bars, etc.	35	1	xxxxxxxx	548,025	xxx	169,575	155,495	3,487,232	xxx	850,424	1,094,346
	Heavy structural shapes	8	2	4,948,200	366,146	87.3	10,858	xxxxxxxx	2,568,638	89.4	102,414	xxxxxxxx
	Steel piling	4	3	422,000	27,328	76.4	3,770	xxxxxxxx	204,583	83.5	17,956	xxxxxxxx
	Plates—Sheared and Universal	19	4	6,294,590	483,238	90.6	17,545	896	3,198,840	87.5	216,633	14,194
	Skelp	8	5	xxxxxxxx	81,169	xxx	10,435	34,133	611,115	xxx	102,312	250,927
	Rails—Standard (over 60 lbs.)	4	6	3,613,600	134,699	44.0	1,361	xxxxxxxx	1,068,394	50.9	43,716	xxxxxxxx
	Light (60 lbs. and under)	6	7	302,800	13,508	52.6	5,432	xxxxxxxx	106,604	60.6	39,246	xxxxxxxx
	All other (Incl. girder, guard, etc.)	2	8	102,000	2,885	33.4	193	xxxxxxxx	15,919	26.9	2,051	xxxxxxxx
	Splice bar and tie plates	15	9	1,300,200	54,000	49.0	907	xxxxxxxx	442,558	58.6	10,570	xxxxxxxx
	Bars—Merchant	35	10	xxxxxxxx	495,210	xxx	23,105	52,446	3,677,933	xxx	299,544	409,326
	Concrete reinforcing—New billet	16	11	xxxxxxxx	127,578	xxx	11,544	xxxxxxxx	844,408	xxx	122,853	xxxxxxxx
	Rerolling	17	12	xxxxxxxx	15,421	xxx	1,297	xxxxxxxx	102,680	xxx	7,980	xxxxxxxx
	Cold finished—Carbon	19	13	xxxxxxxx	94,645	xxx	2,230	xxxxxxxx	702,327	xxx	15,051	xxxxxxxx
	Alloy—Hot rolled	16	14	xxxxxxxx	142,110	xxx	9,400	8,895	975,829	xxx	83,171	84,677
	Cold finished	16	15	xxxxxxxx	17,946	xxx	955	xxxxxxxx	113,728	xxx	12,294	xxxxxxxx
	Hoops and baling bands	5	16	xxxxxxxx	10,923	xxx	104	xxxxxxxx	65,663	xxx	2,340	xxxxxxxx
	TOTAL BARS	53	17	12,217,285	903,833	87.3	48,635	61,341	6,482,568	91.3	541,233	494,003
	Tool steel bars (rolled and forged)	16	18	128,920	11,424	104.5	635	xxxxxxxx	67,093	89.6	4,556	xxxxxxxx
	Pipe and tube—B. W.	13	19	2,049,200	136,931	78.8	8,931	xxxxxxxx	901,664	75.7	71,460	xxxxxxxx
	L. W.	8	20	885,260	44,836	59.7	2,554	xxxxxxxx	289,056	55.4	19,124	xxxxxxxx
	Electric weld	4	21	466,020	53,910	136.5	630	xxxxxxxx	276,889	102.3	13,242	xxxxxxxx
	Seamless	15	22	3,003,840	193,310	75.9	12,674	xxxxxxxx	1,237,106	70.9	118,486	xxxxxxxx
	Conduit	6	23	152,245	12,304	95.4	277	xxxxxxxx	80,754	91.4	1,466	xxxxxxxx
	Mechanical Tubing	12	24	516,725	38,773	88.5	3,391	xxxxxxxx	272,407	90.7	25,283	xxxxxxxx
	Wire rods	14	25	xxxxxxxx	120,027	xxx	13,105	19,993	875,127	xxx	94,016	149,015
	Wire—Drawn	37	26	2,291,250	189,019	97.3	11,157	1,501	1,289,278	96.9	90,560	12,556
	Nails and staples	18	27	1,120,330	61,561	64.8	6,440	xxxxxxxx	473,468	72.7	44,133	xxxxxxxx
	Barbed and twisted	16	28	450,210	22,257	57.3	4,409	xxxxxxxx	164,728	61.9	37,129	xxxxxxxx
	Woven wire fence	15	29	746,180	24,516	38.8	139	xxxxxxxx	193,277	44.6	1,251	xxxxxxxx
	Bale ties	11	30	110,980	7,720	82.1	42	xxxxxxxx	48,361	75.0	141	xxxxxxxx
	All other wire products	5	31	24,280	509	24.7	-	xxxxxxxx	3,757	26.6	-	xxxxxxxx
	Fence posts	13	32	136,195	7,365	63.8	61	xxxxxxxx	44,365	56.1	595	xxxxxxxx
	Black plate	11	33	341,235	40,823	141.1	6,508	-	243,882	123.0	23,245	43
	Tin plate—Hot rolled	7	34	352,700	31,586	105.6	7,964	xxxxxxxx	169,887	82.9	17,842	xxxxxxxx
	Cold reduced	10	35	3,520,640	300,498	100.7	33,044	xxxxxxxx	1,672,473	81.8	155,828	xxxxxxxx
	Sheets—Hot rolled	24	36	xxxxxxxx	583,402	xxx	25,015	17,124	4,398,972	xxx	185,221	129,543
	Galvanized	14	37	xxxxxxxx	120,864	xxx	7,889	xxxxxxxx	1,001,641	xxx	70,824	xxxxxxxx
	Cold rolled	16	38	xxxxxxxx	244,726	xxx	6,186	xxxxxxxx	1,897,387	xxx	41,771	xxxxxxxx
	All other	14	39	xxxxxxxx	59,506	xxx	2,082	xxxxxxxx	466,487	xxx	13,708	xxxxxxxx
	TOTAL SHEETS	27	40	13,154,510	1,008,498	90.4	41,172	17,124	7,764,487	101.6	311,524	129,543
	Strip—Hot rolled	23	41	3,200,380	155,565	57.3	6,515	19,011	1,192,933	64.2	46,666	153,271
	Cold rolled	34	42	1,385,260	99,222	84.5	1,352	xxxxxxxx	700,909	87.1	10,656	xxxxxxxx
	Wheels (car, rolled steel)	5	43	422,825	19,547	54.5	138	xxxxxxxx	146,625	59.7	437	xxxxxxxx
	Axles	4	44	472,280	16,561	41.4	207	xxxxxxxx	102,672	37.4	1,581	xxxxxxxx
	Track spikes	11	45	327,275	13,058	47.1	357	xxxxxxxx	103,129	54.2	2,025	xxxxxxxx
	All other	4	46	24,100	1,451	71.0	-	xxxxxxxx	12,852	91.8	79	xxxxxxxx
	TOTAL STEEL PRODUCTS (a)	134	47	xxxxxxxx	5,226,102	xxx	430,493	307,492	36,509,630	xxx	3,017,880	2,297,898
	Pig iron, ferro manganese and spiegel	24	48	xxxxxxxx	665,037	xxx	35,706	207,802	4,458,198	xxx	316,463	1,352,794
	Ingot moulds	4	49	xxxxxxxx	66,665	xxx	374	xxxxxxxx	429,704	xxx	2,305	xxxxxxxx
Iron Products	Bars	9	50	109,195	6,361	68.7	8	512	39,193	61.8	28	2,548
	Pipe and tubes	3	51	109,300	5,667	61.2	357	xxxxxxxx	38,123	60.0	1,561	xxxxxxxx
	All other	2	52	71,000	2,100	34.9	11	-	11,349	27.5	1,680	-
	TOTAL IRON PRODUCTS (ITEMS 50 to 52)	11	53	224,995	14,128	74.1	376	512	88,665	67.8	3,269	2,548

Total Number of Companies Included - 151

The estimated average yield of products for sale from ingots produced by the companies included above is 71.1%, which applied to their total ingot capacity equals 58,680,500 net tons of finished rolled products.

Production for sale, less shipments to members of the industry for further conversion, related to the estimated yield is as follows:

Current month 4,918,610 *N. T.;* 98.9 %
Year to date 34,211,732 *N. T.;* 102.0 %

(a) Reported by Companies which in 1940 produced 96.5% of that year's total output of Finished Rolled Products.

If You Are Not A Member Of The Wire Association—Now Is A Good Time To Join!
The Annual Dues Are $10.00 — For detailed information address
RICHARD E. BROWN, Secretary
300 Main Street, THE WIRE ASSOCIATION Stamford, Conn.

Exports and Imports of Wire

Iron and Steel Exports Register Further Decline in June

EXPORTS of iron and steel products again declined to reach their lowest point in 14 months when only 398,667 gross tons valued at $35,213,412 were shipped in June. Shipments in May 1941 had amounted to 409,840 tons valued at $35,346,239 and those of June 1940 totaled 617,181 tons valued at $38,771,792.

✦ ✦ ✦

SHIPMENTS during the six months of 1941 totaled 3,016,668 tons valued at $223,202,280, compared with shipments of 2,764,943 tons valued at $197,828,091 during the corresponding period of 1940.

✦ ✦ ✦

NON-ALLOY ingots, blooms, etc. comprised, in point of tonnage, the chief item exported, the 58,595 tons shipped in June closely paralleling the 58,900 tons shipped in May. Pig iron took second place, shipments of 35,402 tons in June running ahead of the 27,444 tons shipped in May. Other commodities important in the June export trade included alloy ingots, blooms, etc., 31,130 tons, non-alloy black steel sheets, 27,255 tons, and tin plate and taggers' tin, 23,700 tons.

✦ ✦ ✦

Imports Gain

IMPORTS of iron and steel (other than scrap) into the United States in June totaled 3,717 gross tons valued at $374,166. Although this trade was twice as large as that of May—1,875 tons valued at $264,591—it was still well below that of June 1940—5,504 tons valued at $530,343.

✦ ✦ ✦

CUMULATIVE six months imports this year are likewise below those of 1940 — the 1941 total being 10,708 tons valued at $1,748,076 as compared with the 1940 total of 38,788 tons valued at $4,499,577.

✦ ✦ ✦

ITEMS important in the June import trade were rails and track material, 1,348 tons, spiegeleisen, 1,245 tons, and ferrosilicon, 622 tons—Canada being the sole source of supply in each instance.

✦ ✦ ✦

CANADA was the chief supplier for the month with 3,323 tons, followed by Sweden with 274 tons, and the United Kingdom with 103 tons.

✦ ✦ ✦

IMPORTS of scrap gained sharply with a total of 6,473 tons as compared with 3,758 tons in May. Cuba was the chief supplier with 4,621 tons, while Canada, 1,187 tons, Bermuda, 657 tons, and the U. S. S. R. (Russia), 8 tons, contributed the remainder.

✦ ✦ ✦

Scrap Exports Lower

AT 59,018 gross tons valued at $1,059,524, scrap exports in

(*Please turn to Page 638*)

AUTOMATIC

STRAIGHTENING and CUTTING MACHINERY

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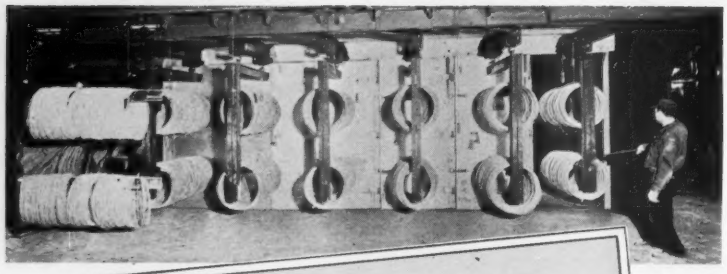

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Exports and Imports of Wire

(*Continued from Page 637*)

June declined slightly from the 62,894 tons valued at $1,260,688 shipped in May of this year. Shipments in June 1940 had amounted to 317,683 tons valued at $5,251,-031.

✦ ✦ ✦

CUMULATIVE exports for the first half of 1941 totaled only 415,880 gross tons valued at $8,-111,351 as compared with 1,478,-806 tons valued at $25,091,838 during the corresponding period of 1940.

✦ ✦ ✦

IRON and steel scrap accounted for 58,937 tons of the total scrap exported. This figure was broken down as follows: No. 1 heavy melting steel scrap, 14,185 tons; No. 2 heavy melting steel scrap, 29,236 tons; baled and bundled scrap, 6,715 tons; cast and burnt scrap, 2,226 tons; and other scrap, 6,575 tons.

✦ ✦ ✦

THE only other scrap item exported was waste-waste tin plate, 81 tons.

✦ ✦ ✦

Cables and Wires

A NEW book entitled "Cables and Wires" by J. Rosslyn has just been published by the Chemical Publishing Company, 234 King Street, Brooklyn, New York, at a price of $2.50 per copy.

✦ ✦ ✦

THIS book is devoted to a consideration of the various types of wires and cables used for the transmission of electric power. It deals with the construction of all the main types of power cables, their characteristics and selection for various working conditions, and may be regarded as a very practical work for insulation engineers, contractors, plant engineers, and works electricians. The book is divided into five parts as follows:

✦ ✦ ✦

1. **Power Cables and Their Applications.**
2. **Jointing and Installing Impregnated Paper Cables.**
3. **The Jointing and Installation of Rubber Insulated Cables.**
4. **Fault Localization in Cables.**
5. **Equipment for Fault Localization in Cables.**

The National Metal Congress and Exposition

GOVERNMENT officials and production executives of defense equipment manufacturers plan a series of defense forums as the main feature of this year's National Metal Congress and Exposition to be staged in Philadelphia's Convention Hall and Commercial Museum the week of October 20th. The purpose of these meetings will be the devising of means for increasing defense production and for the conservation of metal resources and substitutes.

✦ ✦ ✦

RANKING members of the Office of Production Management, Office of Emergency Management, the Army and the Navy will represent the Washington high command at this timely production clinic, according to **W. H. Eisenman,** managing director of the Congress.

✦ ✦ ✦

FROM the numerous industrial contributors scattered about the nation will come leading metallurgists, production men, shop superintendents, efficiency engineers and other operating executives. By a frank discussion of their problems with the government men, an interchange of ideas and a revelation of the most pressing needs of the nation and its sister democracies, it is hoped to iron out throttling difficulties and lend new impetus to defense production.

✦ ✦ ✦

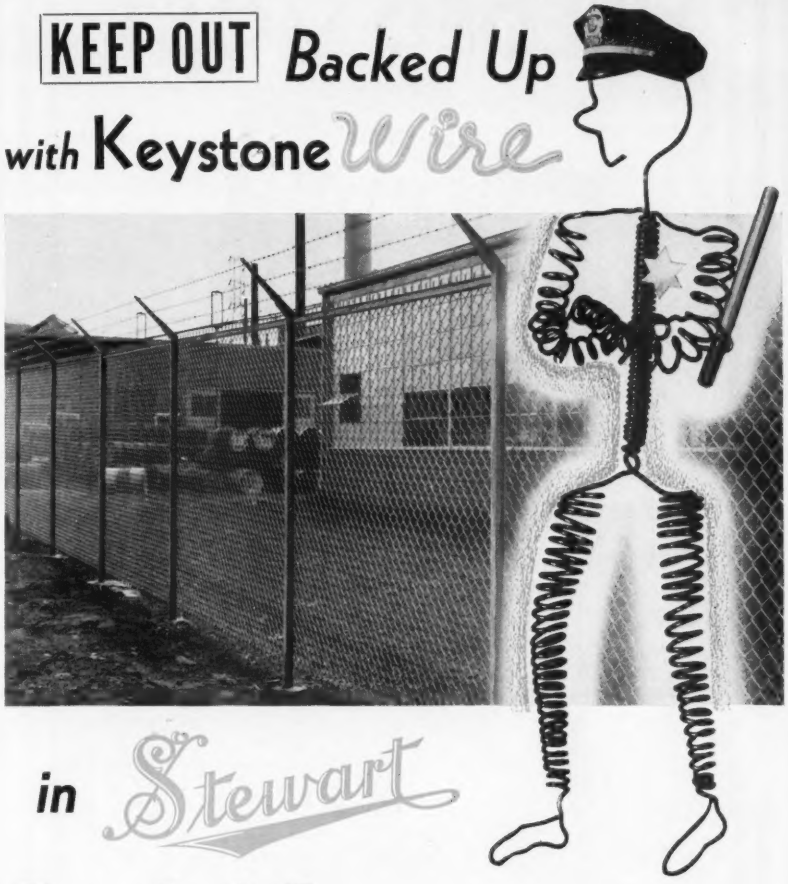
ALL of the vast resources of the Metals Congress, its sponsor, **The American Society for Metals** and the other participating bodies, **The American Welding Society, The Wire Association** and the **Institute of Metals Division** and the **Iron and Steel Division** of the **American Institute of Mining and Metallurgical Engineers,** will be brought to bear on the oiling of defense production machinery and gear it for increased speed and effectiveness, **Eisenman** revealed.

✦ ✦ ✦

"WITH the international situation what it is," said Eisen-

(*Please turn to Page 640*)

KEEP OUT Backed Up with Keystone Wire



in Stewart

Chain Link Fence

Many are the industrial plants, warehouses, storage yards, where an iron-clad "stop" must confront would-be trespassers and saboteurs. Numerous airports, institutions, estates and parks also feel the need of this heavy-duty type of property protection. Standing determined guard night and day around such places you'll find countless miles of Stewart Chain Link fence . . . from coast to coast.

Into this rugged protective fence the Stewart Iron Works, Inc., Cincinnati, Ohio, annually fabricates thousands of tons of Keystone wire.

Stewart, a company with 55 years of established reputation, finds in Keystone wire the easy fabricating and lasting qualities that help them sell their product and keep it sold.

KEYSTONE
STEEL & WIRE CO. Dept. W PEORIA, ILLINOIS

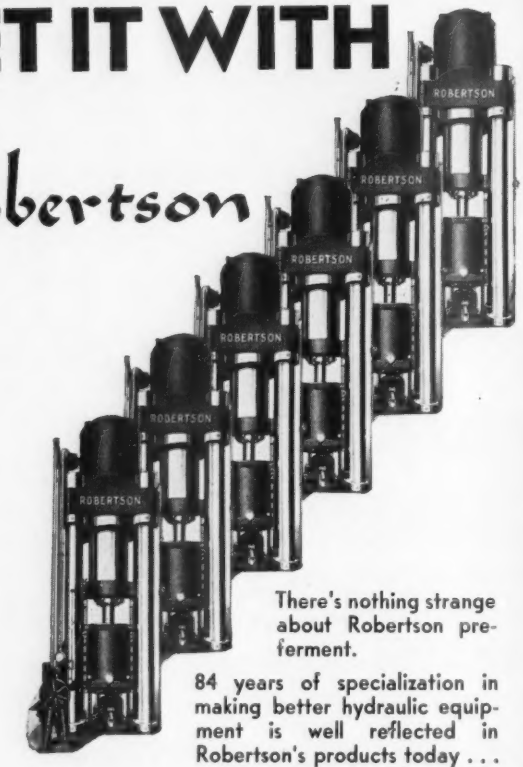
HIGH CARBON OR LOW CARBON
SAMSON SPRING WIRE
REG. U.S. PAT. OFF. KEYSTONE STEEL & WIRE CO. PEORIA, ILL.
Bright-Tinned
Coppered
Annealed
Galvanized

NEEDED MOST:

UNIFORM STEADY OUTPUT!

GET IT WITH

Robertson



There's nothing strange about Robertson preferment.

84 years of specialization in making better hydraulic equipment is well reflected in Robertson's products today . . . reflected in terms of longer life and production without interruption. And these characteristics are mighty important today.

Come to Robertson with your problems.

JOHN ROBERTSON CO., Inc. • 125-37 Water St., Brooklyn, N. Y.

ROBERTSON CABLE LEAD ENCASING EQUIPMENT

HYDRAULIC PRESS • HIGH PRESSURE HYDRAULIC PUMP • CLOSED LEAD MELTING POT

The National Metal Congress And Exposition

(*Continued from Page 639*)

man, "and domestic defense production problems occupying a major portion of industry's attention, it is vital and essential that the program of the **National Metal Congress and Exposition** be projected along the lines of national service and toward conservation of our present resources while at the same time considering substitutes.

✦ ✦ ✦

"INASMUCH as the metal industry constitutes the bone and sinew of our endeavors to establish America as the arsenal of democracy, and because the Metal Congress is the recognized forum of the industry and metal processors, it was natural to dedicate the Congress this year to the expediting of metal production and fabricating, so necessary to our national defense drive.

✦ ✦ ✦

"IN view of these facts and the fact that a large majority of papers being prepared for the Congress and conventions of participating societies deal with subjects vital to those engaged in the arming program, it seemed highly desirable this year to have the main program supplemented by group meetings.

✦ ✦ ✦

"EACH of these meetings will deal with some problem or phase of the defense effort with one or several government speakers and producers and fabricators of metals assigned to each. Among the topics to be covered are:

(1) **"The Manufacture of Shells"**
(2) **"The Molybdenum High Speed Steel"**
(3) **"Tool Steel"**
(4) **"Magnesium for Aircraft and Other Defense Equipment"**
(5) **"Aluminum for Aircraft and Other Defense Equipment"**
(6) **"Copper"**
(7) **"Bearing Metals"**

✦ ✦ ✦

THERE will also be discussions on pig iron, scrap and priorities. Then, too, there will be a series of talks on the conservation of and substitutions for alloyed

metals under the following classifications:

a—Case Hardening
b—Deep Hardening Steels
c—High Strength Structural and Weldable Steels
d—Alloy Castings
e—Stainless and Heat Resisting Steels

✦ ✦ ✦

EXHIBITORS, too, are cooperating to make the Congress of the greatest service to the nation by showing the newest aids for speeding national defense production. Those in charge of these exhibits will sit in on the defense forums to assist in determining new methods for greater productivity by the manufacturers contributing to the program, and will otherwise assist in making this convocation a vital factor in stocking the American arsenal.

✦ ✦ ✦

Tantung "G" Tools in Two New Styles

BLADES for inserted tooth milling cutters and "all-purpose" type lathe tools with full width tips, made of Tantung "G", are listed in two new bulletins from Vascoloy-Ramet Corporation, North Chicago, Illinois.

✦ ✦ ✦

TANTUNG "G" is a patented non-ferrous alloy containing tantalum carbide developed especially for "borderline" machining applications between the ranges of high-speed steel and cemented carbides. It has been found especially effective in increasing production of old machines and cutting operations where the use of cemented carbide tools is hazardous. Tantung "G" tools are also obtainable in solid tool bits and "Economy" type brazed tools.

✦ ✦ ✦

Argentina

UNITED STATES participation in the iron and steel import trade has increased from approximately 43 percent in June 1941 to 61 percent in July, according to the trade.

✦ ✦ ✦

TOTAL imports in July, with the United States share shown in parentheses, were as follows: Sheets, 1,911 short tons (all); tin plate, 17,915 (8,438); pipes, 2,018 (1,780); wire, 3,449 (3,440). The United Kingdom supplied the rest of the tin plate and 9 tons of the wire, Brazil the remainder of the pipes.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:

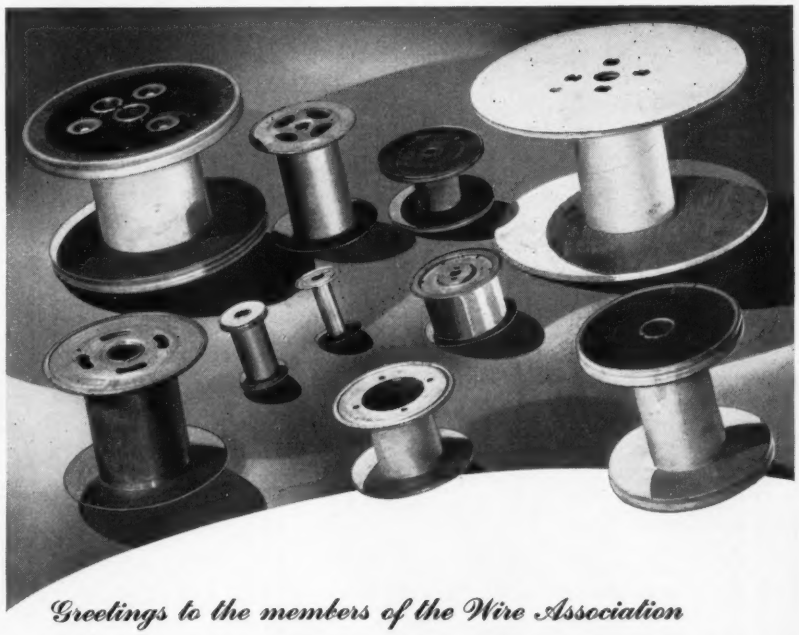
WIRE & WIRE PRODUCTS
Stamford Trust Co. Bldg.,
300 Main St. Stamford, Conn.

Republic Steel Develops New Steel For Surgery

A MOLYBDENUM stainless steel for treatment of bone fractures that has great strength and is free from chemical or electrical reaction has been developed by Republic Steel Corporation. It is used in the form of steel plates, screws, nails and wire in surgery.

✦ ✦ ✦

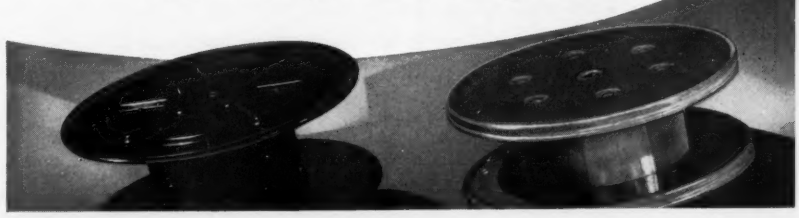
THIS development, according to the company promises "to provide the bone surgeons with stronger and more durable metal that will not corrode in human tissues."



Greetings to the members of the Wire Association

This year, with material priorities and new production demands, conditions are more difficult for all of us. The facilities and experience of this company are helping to solve these problems, and we assure those who look to us as a source of supply that nothing will be left undone to maintain Hubbard quality and service.

HUBBARD SPOOL COMPANY
1622 W. Carroll Avenue, Chicago, Illinois



Wm. H. Spowers, Jr.,
Appointed Lieut. Commander, U. S. N. R.

WILLIAM H. SPOWERS, JR., well-known consulting engineer, specializing in galvanizing, has just been appointed Lieutenant Commander in the U. S. Naval Reserve and ordered to active duty in the Bureau of Ships, U. S. Navy, Navy Building, Washington, D. C.

✦ ✦ ✦

MR. SPOWERS is President of the Spowers Research Laboratory, author of "Hot Dip Galvanizing Practice," and has lectured and written many articles on the various phases of galvanizing.

✦ ✦ ✦

HE is licensed by the State Board of Professional Engineers and Land Surveyors of New Jersey as a Chemical and Mechanical Engineer and is a member of The Wire Association.

✦ ✦ ✦

GALE McCOMB SPOWERS, the oldest son, is attached to the 112th Field Artillery at Fort Bragg, North Carolina and is now attending Officers' Training School at Fort Sill, Oklahoma.

✦ ✦ ✦

ENSIGN CRAIG SPOWERS, the youngest son, was graduated by Annapolis in February and is now serving on the Destroyer U.S.S. Reuben James in the Atlantic Squadron.

✦ ✦ ✦

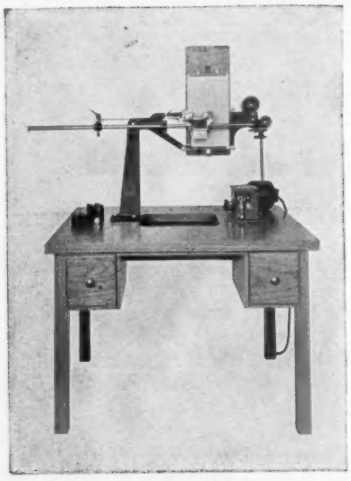
MR. SPOWERS will still maintain offices at 551 Fifth Avenue, New York City for limited consulting work on galvanizing during the emergency.

ENSIGN CRAIG SPOWERS, U. S. N.
Annapolis 1941

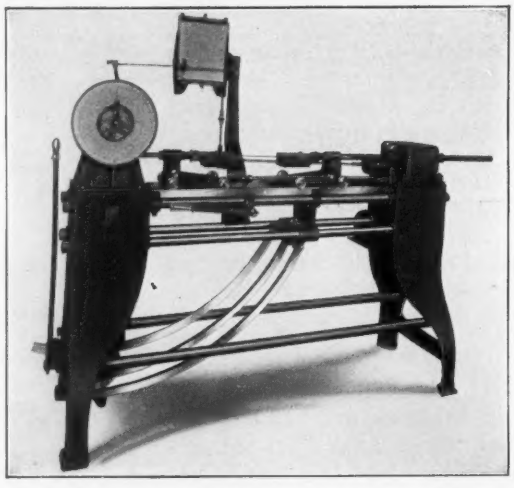
W. H. SPOWERS, JR.
Lieut.-Comdr., U. S. N. R.

GALE McCOMB SPOWERS, U. S. A.
Officers' Training School, Fort Sill, Oklahoma

SCOTT TESTERS



Model IP-2
Maximum capacity
2 pounds



Model Q-5
Maximum capacity
2000 pounds

AUTOGRAPHIC recording tensile testing machines built on either the constant specimen rate of load or constant speed of pull principles. Made in a wide range of models and capacities with high and low stretch magnification recorders - for Wire, Sheet Metals, Rubber, Textiles, Paper, etc.

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ADAM, WILLIAM, JR., Vice President,
Ajax Electric Co.,
Frankford Ave. & Allen St.,
Philadelphia, Pa.

AKIN, W. M., Vice President,
Laclede Steel Co.,
Arcade Bldg., St. Louis, Mo.

ALDRIDGE, D. W., Assistant Works Manager,
British Insulated Cables, Ltd.,
Prescot, Lancashire, England

ALKINS, DR. WM. E., Mgr. of Research Dept.,
Thomas Bolton & Sons, Ltd.,
Oakamoor, North Staffordshire, England

ALLEN, ANTHONY J., Sales Representative,
Pittsburgh Steel Company,
Monessen, Pa.

ANDERSON, ERNEST, G., Chief Met.,
American Hardware Corp.,
New Britain, Conn.

ANGELL, GEORGE, Pres.,
Angell Nail & Chaplet Co.,
4580 E. 71st St., Cleveland, Ohio

ANJESKEY, A. F., Sales Manager,
Cleveland Tramrail Division of the
Cleveland Crane & Engineering Co.,
Wickliffe, Ohio

ATKINSON, L., Superintendent,
Frost Steel & Wire Co., Ltd.,
250 Lottridge St.,
Hamilton, Ontario, Canada

BABB, C. W., Factory Superintendent,
The Columbus Bolt Works,
291 N. Marconi Blvd., Columbus, Ohio

BACKER, SIMON, General Manager,
Backers' Associated Industries,
Box 1, Crane St. Station, Schenectady, N. Y.

BAKER, DAVID, JR., Metallurgical Engineer,
1011 Chestnut St., Philadelphia, Pa.
(American Representative,
Broken Hill Proprietary Co., Ltd., Australia)

BARKER, L. B.,
General Electric Co., Bldg. 96,
Schenectady, N. Y.

BARNINGHAM, CHAS. S., Sales Manager,
New England Butt Co.,
304 Pearl Street, Providence, R. I.

BARTLETT, J. C., Proprietor,
Bartlett Hair Spring Wire Co.,
North Haven, Conn.

BASSETT, CYRUS W., Engineer,
Elevator Supplies Co., Inc.,
Rahway, N. J.

BASSETT, WILLIAM H., JR., Manager,
Metallurgical Development,
Anaconda Wire & Cable Co.,
Hastings-On-Hudson, N. Y.

BAWDEN, WM. D., Gen. Supt.,
Reynolds Wire Co.,
85 Crawford Ave., Dixon, Ill.

BEACH, HAROLD K., Engineer,
Phelps Dodge Copper Products Corp.,
American Copper Products Division,
Elizabeth, N. J.

BEAMAN, P. ALDEN, Sales Manager,
Wire Machinery Department,
Morgan Construction Co.,
15 Belmont St., Worcester, Mass.

BEARD, READE M., Practice Supervisor,
Wire & Nail Mill,
Columbia Steel Co., Pittsburg, Calif.

BEARDSLEE, K. R., General Sales Manager,
Carboloy Company, Inc.,
11171 E. 8-Mile Road, Detroit, Mich.

BEESON, J. K., V. P. Chg. Sales,
Pittsburgh Steel Co.,
Grant Bldg., Pittsburgh, Pa.

BEIGHLEY, ANSON E., Sales Representative,
American Chemical Paint Co.,
2025 Mars Ave., Cleveland, Ohio

BEKAERT, L. A., Managing Director,
S. A. Trefileries Leon Bekaert,
Sweveghem, Belgium

BENKE, C. J., Mgr. Plant #7,
Reynolds Metals Co.,
3rd & Eastern Parkway, Louisville, Ky.

BERGOFFEN, ARCH J., Mgr.,
French Tinsel Co., Inc.,
25 W. 36th St., New York, N. Y.

BICKLE, E. H., Sales Mgr.,
Canadian Steel Corp., Ltd.,
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BILLERBECK, WM. J., Engr.,
American Insulating Machinery Co.,
517 W. Huntingdon St., Philadelphia, Pa.

BINGHAM, ROLAND, Foreman,
Bare Wire Dept.,
General Cable Corp., Rome, N. Y.

BLACK, WINTON SLOAN,
Joint Managing Director,
Speedwell Wire Co., Ltd.,
Speedwell Works, Coatbridge, Scotland

BLOOMBERGH, HOWARD A., President,
Nonotuck Mfg. Company,
Water Street, Holyoke, Mass.

BLOUNT, HARRY, Development Engineer,
Western Electric Co.,
2500 Broening Highway, Baltimore, Md.

BLOUNT, WILLIAM H., Pres. and Gen. Mgr.,
Sleeper & Hartley, Inc.,
Worcester, Mass.

BLOXDORF, WALTER R., Metallurgist,
Macwhyte Co.,
Kenosha, Wis.

BLUM, AL, Asst. Supt. Wire Dept.,
Northwestern Steel & Wire Co.,
Sterling, Ill.

BOGMAN, LIEUT. COL. JAMES H. BEALS,
Signal Corps., U. S. Army,
Office of Chief Signal Officer,
Munitions Bldg., Washington, D. C.

BOLL, JOHN K., Manager Wire Sales Div.,
Wheeling Steel Corp.,
Wheeling, W. Va.

BOND, FRANK A., Vice President,
The McKay Company,
1005 Liberty Ave., Pittsburgh, Pa.

BOONE, J., Gen. Foreman,
Northwestern Steel & Wire Co.,
Sterling, Illinois

BOSWIN, GEORGE A., Gen. Sales Mgr.,
Cable Reel Dept.,
Stevens Metal Products Co.,
Niles, Ohio.

BOULIN, VICTOR J., Manager,
Vianney Wire Die Works,
250 E. 43rd St., New York, N. Y.

BOWMAN, J. W., Pur. Agt.,
Northwestern Steel & Wire Co.,
Sterling, Illinois

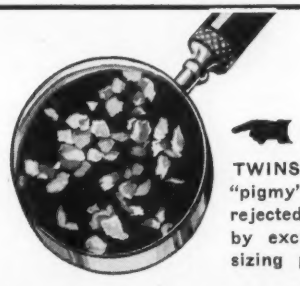
BRALEY, S. A., Chief Met. Field Engr.,
Pittsburgh Steel Co.,
Grant Bldg., Pittsburgh, Pa.

BRERETON, C. F.,
Richard Johnson & Nephew, Ltd.,
Bradford Iron Works,
Forge Lane, Manchester 11, England

BRIGHTMAN, H. M., Asst. to President,
Columbia Steel & Shafting Co.,
Carnegie, Pa.

(Please turn to Page 644)

New "Nopco 99" Soaps

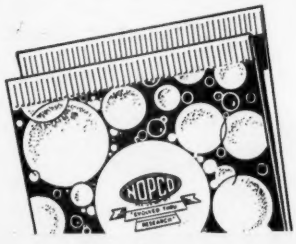


TWINS! "Giant" or "pigmy" particles are rejected without fail by exclusive Nopco sizing process.

Exclusive Process Assures Uniform Particle Size

Once again, Nopco pioneers another precedent - shattering development! Exclusive new method of sizing Nopco dry powdered soaps assures particles uniform as peas in a pod. Select from 3 sizes of Nopco "99" Soaps the exact one best suited to any wire-drawing job — fence, rope, cold heading, stainless or nail. You'll be surprised how sharply costly waste is reduced. You'll save money . . . get better drawing . . . improved results!

Also get full information on Nopco Wet Drawing Compounds for copper, brass and bronze wire, copper and brass tubes and shells, and steel wire.



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(Continued from Page 643)

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(Home address,
4807 Holly St., Kansas City, Mo.)

BRODEN, EDWIN H., Manager, Wire Mills,
American Steel & Wire Co.,
826 Frick Bldg., Pittsburgh, Pa.

BROTEN, O. A., Vice President,
National Pneumatic Co.,
420 Lexington Avenue, New York, N. Y.

BROWN, EVERETT F., Supt., Wire Mill,
American Optical Co.,
Southbridge, Mass.

BROWN, HUGH E., Director of Research,
The W. S. Tyler Company,
3615 Superior Avenue, Cleveland, Ohio.

BROWN, RICHARD E., Publisher,
WIRE & WIRE PRODUCTS,
300 Main Street, Stamford, Conn.

BRUNTON, J. D., President,
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The Western Automatic Machine Screw Co.,
Elyria, Ohio

BRYSON, J. A., Met.,
Burgess-Parr Co., Freeport, Ill.

BUCHANAN, D. D., Mgr. of Operations,
Union Drawn Steel,
Div. of Republic Steel Corp.,
Harsh Ave., Massillon, Ohio

BUCKMAN, L. F., Plant Mgr.,
General Cable Corp.,
3600 E. Olympic Blvd., Los Angeles, Calif.

BULLOCK, MAJOR FRANK W.,
Asst. Dir. of Purchases and Contracts,
Office of the Under Secretary,
War Department, Washington, D. C.

BURNS, J. L.,
Republic Steel Corp.,
118th & Burley Ave., South Chicago, Ill.

BUSH, LIEUT. COL. GEO. P.,
Signal Corps, U. S. Army,
Procurement District of N. Y.,
First Ave. at 58th Street,
brooklyn, New York

BUSSMANN, A. G., Gen. Sales Mgr.,
Wickwire Spencer Steel Co.,
500 Fifth Ave., New York, N. Y.

BUTLER, R. CLYDE, Gen. Wks. Mgr.,
Pittsburgh Steel Company,
Monessen, Penna.

BUTLER, J. F., Superintendent,
Milton Manufacturing Co.,
Milton, Pa.

BUTLER, VICTOR H., Metallurgist,
Baxters (Bolts, Screws & Rivets) Ltd.,
Parade Works,
Sheepcote St., Birmingham, England

CALLAGHAN, JOHN C., Works Mgr.,
Canada Works, Steel Co. of Canada, Ltd.,
Wellington Str., Hamilton, Ontario, Canada

CARNAHAN, H. B., Assistant Works Manager,
Canada Wire & Cable Co., Ltd., & Standard
Underground Cable Co. of Canada, Ltd.,
Box 340, Toronto, Ontario, Canada

CARTER, BEN, Managing Dir.,
B. & F. Carter & Co., Ltd.,
Albion Works,
Waterloo Str., Bolton, Lancs., England

CASEY, AUSTIN B., Sales Engineer,
Syncro Machine Co.,
970 New Brunswick Ave., Rahway, N. J.

CASSIDY, LEVI M.,
Wickwire Spencer Steel Co.,
Station B., Buffalo, N. Y.

CATE, CHESTER L., Wire Mill Foreman,
Republic Steel Corp.,
Gadsden, Alabama

CHAMBRE, LOUIS, Vice President,
Balloffet Dies & Nozzle Co., Inc.,
45-47 Adams St., Guttenberg, N. J.

CHARLIER, PIERRE T., Tech. Dir.,
LaSoudre Electrique Autogene, S. A.,
58-62 Rue Des Deux Gares,
Bruxelles-Midi, Belgium

CLARK, E. W., Mech. Engr.,
Wire & Cable Section,
General Electric Company,
Schenectady, New York

CLARK, HERBERT B.,
Vascoloy-Ramet Corporation,
North Chicago, Illinois

CLEMENTS, W. C., Asst. Met. Engr.,
Bethlehem Steel Company,
Bethlehem, Penna.

CLIFFORD, R. K., V. P. Chg. Oprs.,
Continental Steel Corp.,
Kokomo, Indiana

COCHRAN, ISAAC GEORGE, Supt. Wire Mill,
Laclede Steel Co.,
Alton, Ill.

CONDON, E. J., Master Mechanic,
The Moore Co.,
Muncie, Indiana

COOCH, LOUIS S., Metallurgist,
Buffalo Bolt Co.,
North Tonawanda, N. Y.

COPPICK, JOHN C., Mill Supt.,
Canadian Steel Corporation, Ltd.,
Ojibway, Ontario, Canada

COUSLAND, JOSEPH, Director,
Wm. Riddell, Cousland & Co., Ltd.,
636 Springfield Road, Glasgow, Scotland

CRAIG, HARLAN C., Field Engr.,
Dewey & Almy Chemical Co.,
62 Whittemore Ave., Cambridge B, Mass.

CRANE, CLYDE C., Metallurgist,
Wire Div., Republic Steel Corp.,
7850 So. Chicago Ave., Chicago, Ill.

CRAPO, FRED M., President,
Indiana Steel & Wire Co.,
Muncie, Ind.

CRAWFORD, W. H., Resident Mgr.,
Eaton Mfg. Co.,
Massillon, Ohio

CREWE, L. C., JR., Asst. Supt.,
Rod & Wire Mill,
Bethlehem Steel Co.,
Sparrows Point, Md.

CROSSMAN, A. FRED., Pres.,
Lindsay Wire Weaving Co.,
14025 Aspinwall Ave., N. E., Cleveland, Ohio

CROSSET, D. A., Treasurer and Gen. Mgr.,
Alloy Metal Wire Co.,
Moore, Pa.

CRUM, E. JEFFERSON, Foreman,
Rod & Wire Division
Bethlehem Steel Company,
Sparrows Point, Maryland

CUNY, LIEUT COL. C. D.,
Signal Corps., U. S. Army,
3806 Brandywine Street, N. W.,
Washington, D. C.

DAVIS, BENJ. H., Sales Engr.,
John Royle & Sons,
10 Essex St., Paterson, N. J.

DAY, JAMES, Director,
James Day (Machinery) Ltd.,
The Grange, Whetstone Nr. Leicester, England

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Bunchers
Cablers
Closers
Armor. Machines
Tapers
Juters
Serving Heads
Compound Tanks
Saturating Tanks
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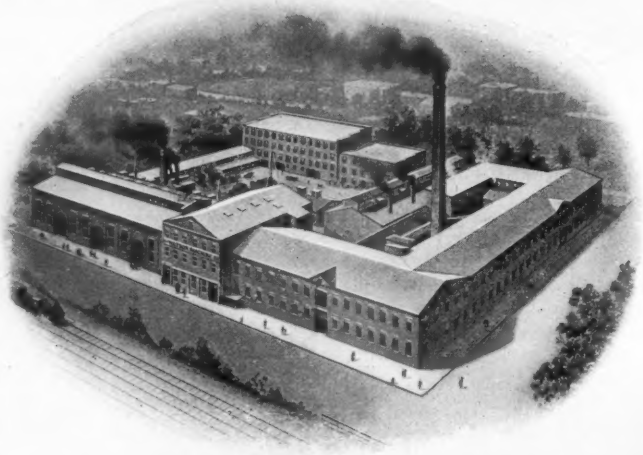
Capstan Sections



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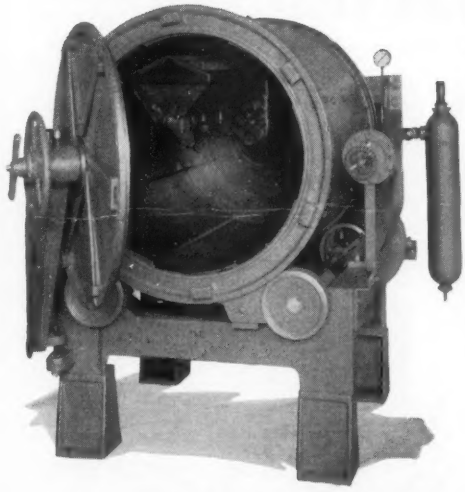

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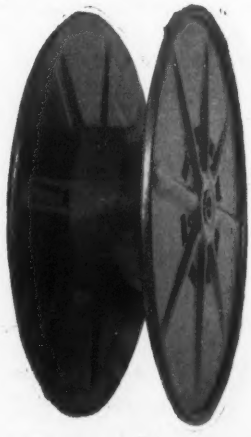

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ORR, C. E., Electrical Engr., Syncro Machine Co., 970 New Brunswick Ave., Rahway, N. J.

PADOWICZ, H. N., Engr., Western Electric Co., 100 Central Ave., Kearny, N. J.

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PAPENDICK, L. W., Asst. Chief Metallurgist, Northwestern Steel and Wire Co., Sterling, Ill.

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PEIRCE, E. H., Supt., Rod & Wire Dept., Wheeling Steel Corp., Portsmouth, Ohio

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PETERSON, R. O., Development Engineer, Osborn Manufacturing Co., 5401 Hamilton Ave., Cleveland, Ohio

PETIX, JOSEPH M., Sales Engr., J. O. Ross Engr. Corp., 350 Madison Ave., New York, N. Y.

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(Please turn to Page 650)

FOR FASTER, SMOOTHER PRODUCTION

Wherever solder is used in the manufacture of wire products, Kester Cored Solders can increase the efficiency of the operation. That's because the self-contained, scientifically-correct fluxes make for faster, neater work—and because only virgin metals are used. Solder and flux are properly balanced—both, in the right kind and quality—for perfect results.

Kester Cored Solders come in a wide range of alloys, fluxes and sizes, among which is the best combination for any industrial requirement. Kester engineers are at your service to help you solve any production difficulty involving the use of solder. Write to them; state your problem fully. There is no obligation.

KESTER SOLDER COMPANY

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KESTER CORED SOLDERS
STANDARD FOR INDUSTRY

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(Continued from Page 649)

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NEW — AND BETTER

The *Trauwood* PROCESS

The Trauwood Process for the continuous patenting, tempering and annealing of steel wire and strip utilizes a new principle of heating — the heating effect of an electric current is employed to heat the work rapidly and uniformly through the cross section to the required temperature.

. . . High temperature furnaces and lead pots with their excessive maintenance costs are eliminated.

OUTSTANDING ADVANTAGES

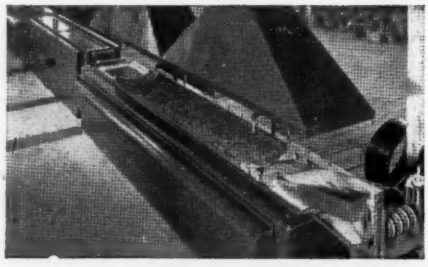
Higher and more uniform physical and fatigue properties.
No surface decarburization or scale.
Faster wire speeds . . . greater production.
Equipment fully automatic and easy to operate.
Control of heating and cooling cycles extremely accurate.
Thermal efficiency of the process very high.
Much finer grained structure possible.
High quenching temperatures rapidly attained.
Adaptable to high alloy and austenitic steel wire and strip (annealing of stainless).

The Trauwood Process, new in principle, eliminates high temperature furnaces and lead pots with their excessive maintenance costs and low thermal efficiencies. More positive temperature control is possible and quenching is done on a rising temperature — instead of falling, as in conventional heat treating methods. The rapid rate of heating (4 to 5 times as fast as furnace heating) increases production and uniformly produces a finer grained product with higher physical and fatigue values.

Wire and rod patented by the Trauwood Process insure easier drafting make heavier reductions possible.

Complete details of the Trauwood Process will be furnished you on request. Our engineers will help you solve your continuous wire and strip patenting, tempering, and annealing problems. Write today

PATENTING
TEMPERING
ANNEALING



Trauwood Electric Wire Tempering and Patenting Unit

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ZOUCK, JOHN, Chief Inspector,
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ZUR, JOHN P., Met. Engr.,
Trauwood Engineering Co.,
1740 E. 23rd St., Cleveland, Ohio

Indiana Wire Die Company

ANNOUNCEMENT is made of the organization and opening of business as of June 4th, 1941 by the Indiana Wire Die Company, 1207 East Creighton Avenue, Fort Wayne, Indiana.

✦ ✦ ✦

MR. O. G. FERRIER is in charge and the company is making a specialty of producing wire drawing dies in fine sizes.

Callite is geared to supply you with fine wires demanding close control of temper, tolerance and finish in a wide range of base and alloy metals. Here is a partial list, characterized throughout by a degree of quality and uniformity that has long made Callite fine wires top choice in many fields. Available in sizes down to .002", or finer in certain cases.

Aluminum • Beryllium-copper • Stainless steel • Phosphor-bronze • Silver • Silver bullion wire • Nickel alloys • Brush wire • Monel • Brass — all grades • Commercial bronze • Nickel-silver alloys • Special alloys

Callite's engineering staff is at your service for development and research on your specific problems. Whatever your needs, investigate Callite fine wires today.

Callite Wires

CALLITE TUNGSTEN CORPORATION
572 39TH STREET • UNION CITY, NEW JERSEY
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CALLITE TUNGSTEN CORPORATION CT

A FINE WIRE FOR EVERY NEED

"Cease and Desist" Orders Issued By F.T.C. Against Makers of Wire Tying and Strapping Machines

RECENTLY the Federal Trade Commission issued "cease and desist" orders against the Gerrard Company, Inc., manufacturer of wire tying machines and appliances and American Steel & Wire Company, owner of virtually all of its capital stock; Signode Steel Strapping Company, manufacturer of strap and wire tying machines and appliances and of wire and strapping; and Acme Steel Company, maker of tying tools, machines and appliances and of steel straps and bands. The order charges that the carrying out of "tying" contracts in the leasing of such machines and in the sale of steel wire or strapping has been in violation of the Clayton Anti-Trust Act.

✦ ✦ ✦

BETWEEN 10 and 15 companies in the United States furnish tying machines with approximately three-fourths of the business, according to findings, being done by the Gerrard, Signode and Acme companies. The industry does a gross annual business in machines, wire, strapping and other supplies of approximately $9,000,000. There are some 100,000 tying machines in use throughout the country, of which about 80,000 are flat band or strap machines and about 20,000 are wire machines.

✦ ✦ ✦

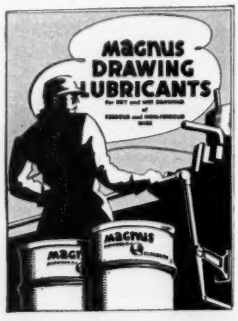
COMMISSION findings are that the respondent companies have required leasees of their machines or appliances to use in such machines no wire or strap other than supplied them by the respondents' practices result in the exclusion from the market of numerous parties, who, in the absence of such restrictions would be prospective and potential purchasers of tying wire or strapping from the respondents' competitors. Such competitors sell wire or strapping suitable for use in the respondents' machines.

✦ ✦ ✦

New Bulletin Issued by Magnus Chemical Company

THE **Magnus Chemical Co., Inc.,** has just issued a new bulletin entitled "Magnus Drawing Lubricants For Dry and Wet Drawing of Ferrous and Non-Ferrous Wire."

✦ ✦ ✦



THE bulletin thoroughly discusses the qualities that should be sought for in wire drawing lubricants—qualities that insure smooth, bright finish, longer die life and greater poundage of wire per die.

SAVE ZINC

In your hot galvanizing operations with

DEWALCO LIQUID BLANKET

★ PREVENTS FORMATION OF ZINC OXIDE

★ CUTS HEAT LOSSES

★ REDUCES DROSS

Cutting your waste of zinc metal increases the amount of material you can galvanize with your present stocks of prime metal.

WRITE FOR DETAILS

DEWEY AND ALMY CHEMICAL COMPANY • CAMBRIDGE, MASS.

UNDER the heading "Dry Drawing," the bulletin discusses the drawing of steel wire, medium and low carbon; high carbon and stainless steel wire; and high speed continuous drawing of low carbon steel. The section devoted to wet drawing covers the drawing of steel, bronze and brass wire; fine monel or stainless steel wire; fine steel wire and copper, brass and bronze wire. Another section describes materials for grease drawing of wire. There are also separate sections on wire coating, wire cleaning and rust protection.

✦ ✦ ✦

THE bulletin should prove very helpful to all those concerned with more efficient and economical drawing of all types of wire. Copies of the Magnus Drawing Lubricants bulletin can be obtained by writing to the **Magnus Chemical Co., Inc., Garwood, N. J.**

✦ ✦ ✦

Production of Commercial Bronze Screen Cloth Wire

(*Continued from Page 615*)

A LARGE intermediate multiple die machine is used to draw the rods from $\frac{5}{16}$" to 0.051"; 10 dies are used, of which the first 9 are Carboloy, and the last one a diamond. A water emulsion lubricant relatively high in free fats is continously circulated on to the dies during the drawing operation, and the finished wire comes from the machine at the rate of 2500 ft. per minute. The die sizes and approximate reductions on the wire are shown in Table II.

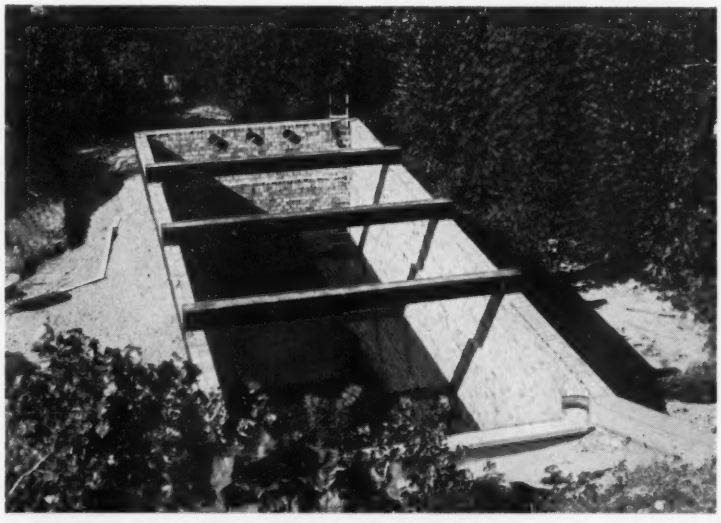
✦ ✦ ✦

The Finishing Operation

THE hard wire on 0.051", which has a tensile strength of approximately 112,000 pounds per square inch, is placed on a finishing machine and drawn directly to 0.0113" using 13 diamond dies with regular Brown & Sharpe gauge reductions. The same lubricant is used on this machine as on the intermediate one, and the finished wire — of which a photomicrograph is shown in Figure 6 — also comes from the machine at the rate of 2500 ft. per minute. The finished hard wire has a tensile strength of approximately 130,000 pounds per square inch, and is made into small diameter coils which weigh between 20 to 22 pounds each, and the individual coil is tied with its own wire. Two bundles or coils are tied together with string in four different places and packed in a barrel lined with waterproof paper, ready for shipment. In some plants the finished wire is spooled and sent directly to the screen cloth manufacturer so that he can immediately set it up on his weaving equipment.

For Information Regarding The Wire Association Address
Richard E. Brown, Secretary
Stamford Trust Co. Bldg.
300 Main Street, Stamford, Conn.

BASOLIT
Acid *Neutralizing* Tank



2500 gallons of waste pickling acid are dumped every 24 hours into this 90,000 gallon acid disposal tank recently installed for a large wire mill in the Mid-west.

Tank is 60 ft. long, 20 ft. wide and 12 ft. deep, constructed of reinforced concrete shell, lined with Toronto Acid Brick and acid-proof jointing Cement, BASOLIT.

There are many hundreds of rubber lined steel and reinforced concrete pickling tanks, acid storage and neutralizing tanks and acid floors, sewers and pits, where our BASOLIT construction has contributed to long life and efficient operation of modern pickling equipment.

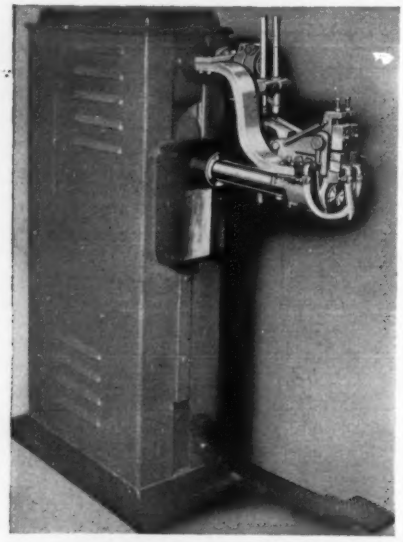
Our Engineering Department will be pleased to furnish detailed drawings and estimates without cost to you.

NUKEM PRODUCTS CORP. 72 Niagara St. Buffalo, N. Y.

New York Steubenville, O. Pittsburgh Detroit

New Butt Welding Attachment

ANY rocker arm type Spot Welder may now be quickly converted into a butt welder by simply removing the arms and inserting in their place the upper arm and lower arm sections of the



Universal Butt Welding Attachment. No cables or rods needed as entire operation is automatically carried out by motion of upper arm.

✦ ✦ ✦

A STEP on the pedal clamps jaws simultaneously, pushes movable die toward stationary slide, applies weld current, completes weld and upset and pulls the slide back ready for next weld. Butting surfaces quickly forge with uniform porosity free weld practically equal to parent metal in strength.

✦ ✦ ✦

AVAILABLE in two sizes—two to ten KVA and 12 to 25 KVA —the first good for ⅜ dia. solid stock, the second up to ¾" dia. solid. (The jaws of the larger unit may be extended to 1" dia.)

✦ ✦ ✦

BOTH units may be used for making butt welds on tubular stock, and are useful in many instances in the fabricating of wire products. This Butt Welding Attachment is manufactured by the Universal Power Corporation, 4300 Euclid Avenue, Cleveland, Ohio.

Signal Depot Removed From Brooklyn to Philadelphia, Pa.

BECAUSE of the rapid expansion of the Signal Corps Procurement Services it has been found necessary to remove the New York Signal Corps Procurement District and Signal Depot of the U. S. Army from its present limited quarters at 1st Avenue & 58th Street, Brooklyn, New York, to Philadelphia, Pa.

✦ ✦ ✦

BOTH the New York Signal Corps Procurement District and the Signal Depot will be moved during the month of October to the old Atwater Kent plant at Wissahickon and Abbottsford Avenues, Philadelphia, Pa.

✦ ✦ ✦

MANUFACTURERS formerly calling to discuss matters at the Brooklyn Signal Corps Depot will find the same pleasant facilities extended to them by the Signal Corps in their new location at Philadelphia.

PRECISION WIRE FOR DEFENSE

If practice makes perfect - - - we are deserving of our reputation for high quality wire. Our master craftsmen average twenty-five years experience in the drawing of fine wire.

Your Inquiries are Invited

Range: .192" to .005"

SPENCER WIRE COMPANY

WIRE VILLAGE

SPENCER • MASSACHUSETTS

Speaker At National Defense Luncheon of the Wire Association On the Subject "What Are We Defending?"

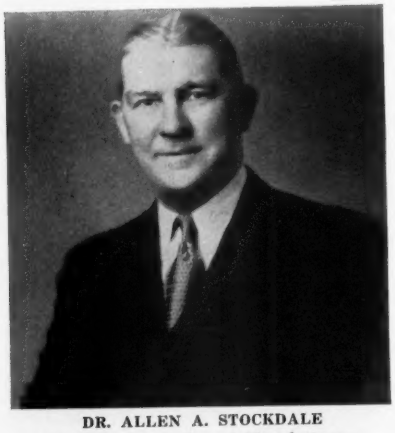
Dr. Allen A. Stockdale

National Association of Manufacturers

DR. ALLEN A. STOCKDALE, who is ranked as one of the most eloquent speakers on the American platform was born in Zanesville, Ohio. He was graduated from the Boston University School of Theology and did postgraduate work in philosophy and sociology. He was a resident student at Oxford University, England, in 1922-23.

✦ ✦ ✦

DR. STOCKDALE has held pastorates in Boston, Toledo, Chicago, and most recently at the First Congregational Church in Washington, D. C.



DR. ALLEN A. STOCKDALE
National Association of Manufacturers

DURING his residence in Boston, Dr. Stockdale was chaplain of the Emerson College of Oratory and at present he is a trustee of that institution.

✦ ✦ ✦

DR. STOCKDALE served for six months in France during the World War, as a Red Cross field director with the commission of captain. He was with the Second Division near Soissons in July, 1918, at the opening of the big drive.

✦ ✦ ✦

DR. STOCKDALE is the author of many bits of well-known poetry. He was at one time editorial contributor to the "Peoples Home Journal" and the "Congregationalist" and was formerly editor of the devotional magazine called the "Reveille."

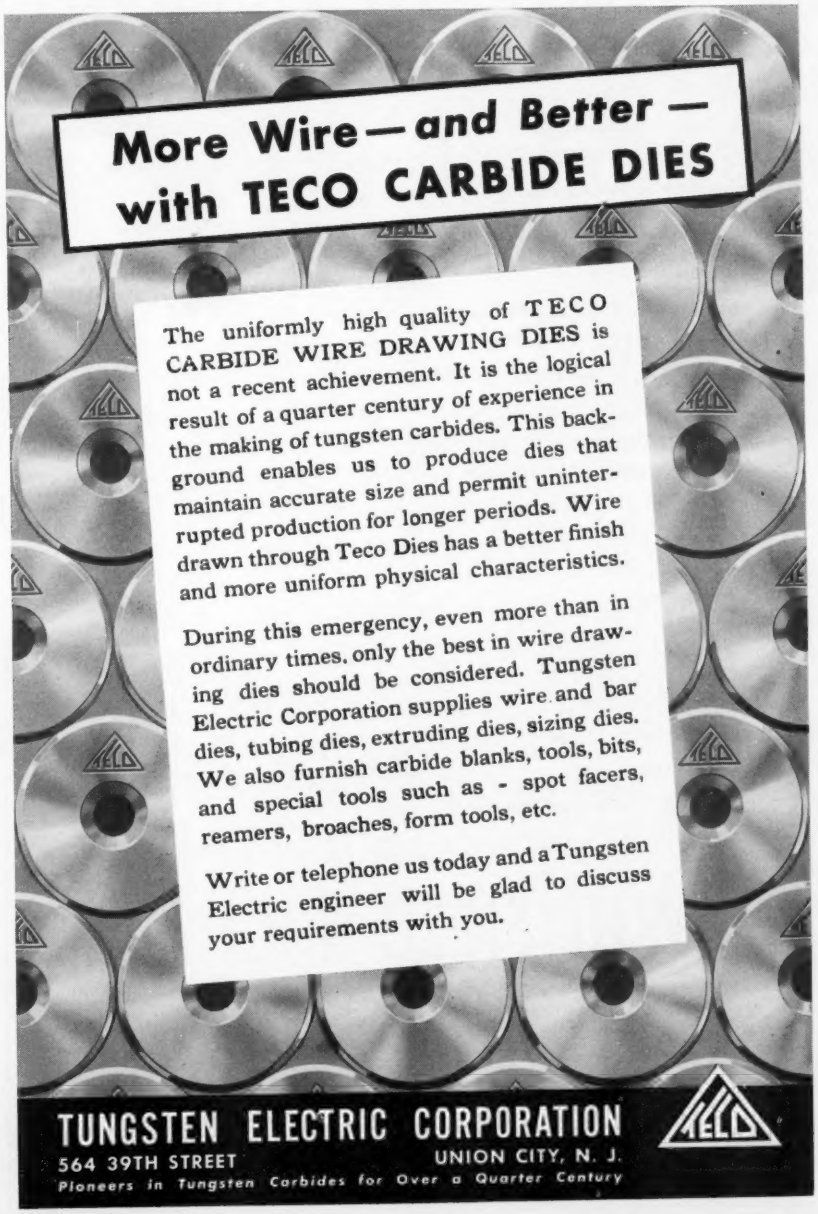
✦ ✦ ✦

SINCE November 1, 1937, Dr. Stockdale has been speaking exclusively for the National Association of Manufacturers.

For Information Regarding
The Wire Association, Address —
Richard E. Brown, Secretary
300 Main Street, Stamford, Conn.

R. J. Forkey, Sales Engineer, Norton Co.

R. J. FORKEY has been appointed sales engineer for upper and western New York state by **Norton Company**, Worcester, Mass. Mr. Forkey, a graduate of Worcester Polytechnic Institute, has been connected with the research laboratories and the sales engineering department at the Worcester plant.


More Wire—and Better—with TECO CARBIDE DIES
The uniformly high quality of TECO CARBIDE WIRE DRAWING DIES is not a recent achievement. It is the logical result of a quarter century of experience in the making of tungsten carbides. This background enables us to produce dies that maintain accurate size and permit uninterrupted production for longer periods. Wire drawn through Teco Dies has a better finish and more uniform physical characteristics.
During this emergency, even more than in ordinary times, only the best in wire drawing dies should be considered. Tungsten Electric Corporation supplies wire and bar dies, tubing dies, extruding dies, sizing dies. We also furnish carbide blanks, tools, bits, and special tools such as - spot facers, reamers, broaches, form tools, etc.
Write or telephone us today and a Tungsten Electric engineer will be glad to discuss your requirements with you.
TUNGSTEN ELECTRIC CORPORATION
564 39TH STREET
UNION CITY, N. J.
Pioneers in Tungsten Carbides for Over a Quarter Century

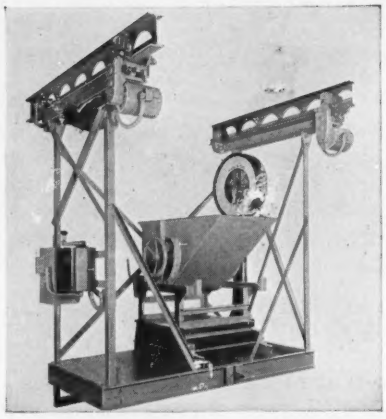
Traveling Batch Scale Car

A TRAVELING batch scale car has been developed by the **Cleveland Tramrail Division of The Cleveland Crane & Engineering Company, Wickliffe, Ohio.** It is particularly suited for the handling of batch materials entering into the manufacture of rubber and clay products. It can be adapted to the handling of chemicals and batch materials used in a variety of industries.

THE car is motor driven and controlled by an operator who rides on the platform space provided to the left of the bucket. A variable speed drum controller permits the car to be traveled at any speed up to 300 feet per minute.

✦ ✦ ✦

DOUBLE overhead rails make it possible to straddle overhead bins so that their chutes may be brought close to the car bucket.



THE unit makes it possible to gather the exact amounts from various bins that go to make up a batch. The scale on the car accurately weighs the ingredients as they are dumped in. The bucket is easily emptied by tilting through use of a crank wheel.

✦ ✦ ✦

THE unit illustrated will handle batch loads of one-half ton. Other **Cleveland Tramrail** traveling batch scale cars can be provided to meet individual requirements.

✦ ✦ ✦

Time, Temperature, and Size in the Heat Treating of Steel Wire

(Continued from Page 603)

from the muffle with changes in structure ranging from fine pearlite (patented structure) to spheroidized pearlite.

8. Surface reflectivity influences time in radiant heating, a highly reflecting surface requiring at least 25% more time than a dull surface.

9. Minor variations in required time in lead heating may be caused by coatings which may vary in heat conductivity.

10. Mass influence affects the time required according to laws which are individual to individual conditions. Empirical values in the law governing time and size relations must be established for individual equipment, and for the mode or modes of heating involved, as well as for the type of process under consideration.

G. WHITFIELD RICHARDS

has been specializing in the production of cutting and drawing lubricants for practically half a century. Such a background has, as a consequence, brought us into direct contact with the most diversified requirements in our manufacture of drawing compounds to meet the varied demands of the drawing industry.

Have You A Drawing Problem?

If you have a drawing problem or if you are desirous of improving your present procedure may we have an opportunity to cooperate with you. Our past experience and constant development of lubricants to meet the ever increasing demands of the drawing trades should be of marked assistance. Moreover we would like to work with you and feel confident that such an arrangement would prove mutually beneficial. May we have this opportunity? Our representatives are most willing and able to assist and their time and ability plus the whole-hearted cooperation and experience of our manufacturing department is yours for the asking. Write us about it—won't you?

G. WHITFIELD RICHARDS

1732-36 Carlton St.
PHILADELPHIA, PA.

Wire Drawing Powder; Water Soluble Lubricants for Continuous Machines; Lubricants for Cold Header Stock; Extreme Pressure Bull Block Greases; Single and Multiple Hole Bright Wire Greases; Drawing Oils, etc.

If You Are Not A Member Of The Wire Association — Now Is A Good Time To Join!

For detailed information address

RICHARD E. BROWN, Secretary

THE WIRE ASSOCIATION

300 Main St., Stamford, Conn.

A Review of Recent Wire Patents

No. 2,250,800, INNER SPRING UNIT, patented July 29, 1941 by Frederick G. Hodges, Jr., Dallas, Tex.

Fastening clips are provided for securing one end of one spring to the adjacent end of the next spring and both to an insulation pad.

✦ ✦ ✦

No. 2,251,093, WIRE DRAWING LUBRICANT AND METHOD OF PRODUCING THE SAME, patented July 29, 1941 by Robert C. Williams, Columbus, Ohio, assignor to The Ironsides Company, Columbus, Ohio, a corporation of Ohio.

The lubricant of this patent comprises an intimate mixture of a finely divided grit-free base material of the class consisting of hydrated lime, calcium carbonate, barium sulphate, clay and bentonite and composed of a multitude of small solid particles, and a soap distributed uniformly over the surface of the individual particles of said material by means of a solvent solution of the soap from which the solvent subsequently is removed from the mixture.

✦ ✦ ✦

No. 2,251,205, APPARATUS FOR WINDING WIRE AROUND A BODY OF REVOLUTION, patented July 29, 1941 by Maurice Revel, Paris, France, assignor to Societe des Tuyaux Bonna, Paris, France, a corporation of France.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

Wire is placed at a low prime tension and the tension is increased so that the carriage will move in accordance with the tension of the wire.

✦ ✦ ✦

No. 2,251,355, INSULATED ELECTRICAL CONDUCTOR, patented August 5, 1941 by John W. Greenleaf, Hamden, Conn., assignor to Rockbestos Products Corporation, a corporation of Massachusetts.

The wire conductor is said to be capable of being heated to a high temperature and may be subjected to considerable bending and abrasion. The covering comprises a sliver of asbestos helically wound about a core of glass thread.

✦ ✦ ✦

No. 2,252,352, WIRE DRAWING MACHINE, patented August 12, 1941 by Robert C. Pierce, Niles, Mich., assignor to National Standard Company, Niles, Mich., a corporation of Michigan.

In addition to the die and capstan for drawing the wire vertically downwardly through the die, there is a back-tension means, including a vertically-movable part whose vertical position is varied by variations in the feeding of the wire through the die.

✦ ✦ ✦

No. 2,252,421, ALLOY, patented August 12, 1941 by Philip T. Stroup, New Kensington, Pa., assignor to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania.

An aluminum conductor metal is provided containing from 0.01 to 0.5 per cent of boron and from 0.01 to 1 per cent total of at least one of the group of impurities consisting of chromium, titanium, zirconium, vanadium, and molybdenum, the conductor metal being characterized by having an electrical conductivity greater than of the same metal devoid of boron.

✦ ✦ ✦

No. 2,252,755, METHOD OF SATURATING FIBROUS COVERINGS ON WIRES, CABLES, AND THE LIKE, patented August 19, 1941 by Carl O. Bruestle, Rahway, N. J., assignor to Elevator Supplies Company, Incorporated, Rahway, N. J., a corporation of New Jersey.

Hot, liquified impregnating material is forced into the fibrous covering at successively increased pressures, while the

(Please turn to Page 658)

DIES MADE BY WILLEY'S

Sales Engineers in Principal Cities.

Standard Sizes from .015 to 2.250. Special Sizes and Shapes Made to Order.

are uniformly good.

A special grade of Tungsten Carbide plus exacting standards of manufacture give Willey's dies exceptional qualities.

Micrometer accuracy.

Great resistance to abrasion.

Take a polish equal to that of diamonds.

Ideal for sizing, extrusion and wire drawing.

Willey's Dies are made in four classifications:

A. *Blank and Rough Cored Nibs.*
B. *Rough Cored Dies (Cased)*
C. *Semi-Finished Dies, Rough Drilled (Cased)*
D. *Finished Dies Ready for Use.*

WILLEY'S CARBIDE TOOL CO.

1340 West Vernor Highway

Detroit, Michigan

A Review of Recent Wire Patents

(Continued from Page 657)

application of the material is limited to a time interval so as to increase the temperature of the wire only to a low degree.

✦ ✦ ✦

No. 2,253,138, ELECTRICAL CABLE, patented August 19, 1941 by Manuel H. Savage, Bridgeport, and Edmund J. Butler, Stratford, Conn., assignors to General Electric Company, a corporation of New York.

An insulated electrical conductor is provided in which the insulation comprises a product of vulcanizing an extrudable composition comprising rubber, asphalt, a reaction product of rubber and a halogen acid of tin, and a vulcanizing agent.

No. 2,253,173, WIRE COATING APPARATUS, patented August 19, 1941 by Edward J. Flynn, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York.

The assembly includes a receptacle containing a bath of substantially quiet coating material, means for supplying the material thereto, means for maintaining constant the depth of the bath, and means for drawing the wire through the bath, this receptacle having a side provided with an upwardly opening slot through which the wire may be passed by a transverse movement to and from its coating position.

✦ ✦ ✦

No. 2,253,967, INSULATED ELECTRICAL CONDUCTOR, patented August 26, 1941 by Leonhard Carl, Berlin—Friedenau, and Paul Nowak, Berlin—Charlottenburg, Germany, assignors to General Electric Company, a corporation of New York.

About the wire conductor is a helical wrapping of an unplasticized cellulose triacetate capable of withstanding temperatures of 130°C. without deterioration on this conductor, and an outer covering vulcanized in situ comprising a polymerized butadiene derivative resulting from the polymerization of butadiene in the presence of metallic sodium, the cellulose triacetate wrapping being mechanically and electrically the same after vulcanization of the butadiene derivative as when applied to the conductor prior to vulcanization.

✦ ✦ ✦

No. 2,253,986, GAS FILLED CABLE, patented August 26, 1941 by George B. Shanklin, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York.

A wax-forming compound is employed and neutral gas, the latter being under such controlled positive pressure that incipient ionization discharge may take place temporarily under load conditions, the wax formed by the liquid being forced by the gas into the localized void where such discharge started for healing it.

✦ ✦ ✦

No. 2,254,106, SPRING LOCK, patented August 26, 1941 by Abraham Krakauer, Brooklyn, N. Y., assignor to Kay Manufacturing Corporation, Brooklyn, N. Y., a corporation of New York.

This comprises a wire lock device for a helical coil bed spring (or like) assembly.

✦ ✦ ✦

"Inspection of Metals"

A NEW book, described as a most complete manual on the inspection of metals, and written by a recognized authority in the metallurgical field to fill a definite need of the defense program, is being published by the American Society for Metals as a contribution to a speedier and more effective rearming of the nation. The book will be sold at cost.

✦ ✦ ✦

"INSPECTION of Metals" is by **Harry B. Pulsifer,** metallurgical engineer with the American Metal Treating Company and consulting metallurgist with the Ferry Cap and Set Screw Company of Cleveland; formerly assistant professor of metallurgy, Lehigh University; in charge of development laboratory, Beryllium Corporation of America; director of district laboratory and works metallurgist, American Steel and Wire Company, Cleveland.

✦ ✦ ✦

INCLUDED among the topics covered by the book are—

All-Metal WIRE SPOOLS

CABLE SPOOLS . . . *for Insulated and Rubber Covered Wire, Solder, and similar products.*

These spool ends are formed from cold rolled steel of gauges to meet specific demands for strength. The edges are curled and ribs embossed for increased rigidity. Panels may be worked into your design and embossed, for use in marking size and variety. All parts are lithographed for identification purposes and to protect the metal.

Ends and traverses may be shipped unassembled. A simple operation on a hand, foot, or power press makes rigid and permanent assembly.

Made in 5", 6½" and 10½" diameter Ends; Traverses 1 15/16" diameter (or special 3½" diameter for 10½" End), in any desired lengths.

FINE WIRE SPOOLS . . . *for winding and shipping Fine, Steel, Copper, and Enameled Wires.*

Spools are formed from tin plate tested for maximum rigidity. Made with locked-seam barrel and one-piece ends, they are so assembled that there is no possibility of wire being trapped in the joint where barrel and end meet. Ends are made with full curl on edge, which provides additional strength and a smooth winding edge.

Entire spool may be finished with gold lacquer or a variety of colored lacquers; with or without identifying copy embossed in the ends.

Made in 2 7/16" and 3" diameter Ends. The 2 7/16" size is made with 1½" diameter Traverse only; the 3" diameter with 1½" or 1¾" diameter Traverse.

We will send samples at your request.

J. L. CLARK MANUFACTURING CO.
600 23rd AVENUE • ROCKFORD, ILLINOIS

"Ideals in Steel Making"; "Surface Inspection"; "Tensile Testing Including Shear"; "Microscopic Structures and Patterns"; "Coatings and Corrosion Testing" and "Impact Fatigue and Creep Testing".

✦ ✦ ✦

"INSPECTION of Metals," a stripped-for-action handbook, covering the whole field of the testing of metals for ordnance, armament and other phases of the national defense effort, contains only essentials and is written in a style comprehensible to the hastily trained emergency worker as well as the veteran metals man.

✦ ✦ ✦

FOLLOWING a review of an advanced copy of Dr. Pulsifer's work, the office of the Chief of Ordnance, War Department, warmly praised the book and commended the efforts of Dr. Pulsifer and the American Society for Metals in publishing the book as a worthy public service.

INASMUCH as the book was written and published in the interests of national defense and those so engaged, it has been made available at the cost of production—$1.00, and may be obtained from the American Society for Metals, 7301 Euclid Avenue, Cleveland, Ohio.

✦ ✦ ✦

Central Steel & Wire Occupy New Quarters

THE plant and offices of the **Central Steel & Wire Company** have been consolidated and are now located on a fifteen acre tract at 3000 W. 51st Street, Chicago. Previously the offices had been at 4545 S. Western Avenue.

✦ ✦ ✦

NEW offices of the company were constructed at the 51st Street address and a large addition was built to the plant. The capacity is now almost double, making it one of the largest warehouses in the United States.

High Speed Rotary Knitting Machines for Covering Electrical Conductors

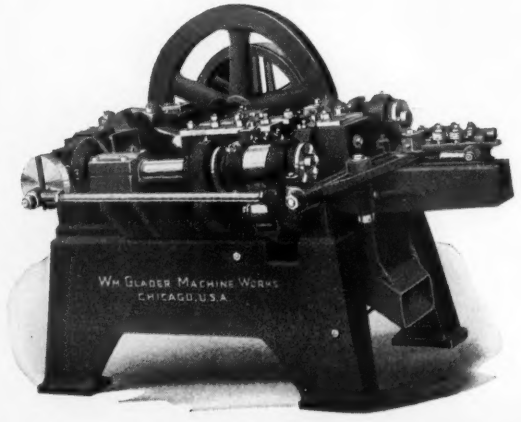
(*Continued from Page 611*)

pect that they can be made equally as good.

✦ ✦ ✦

SAMPLES 8 and 9 show the type of knitted covering most suitable for telephone drop wires in which maximum protection against sunlight, good abrasion resistance and handling properties are desired. The first or inner covering was applied inside-out so that the loops form on the outer surface and intermesh with the loops on the inner surface of the outer covering. Knitted coverings of this type retain the advantage of high speed application inasmuch as they may be fabricated with a double head machine unit.

GLADER WIRE NAIL MACHINE SCORES AGAIN



WM. GLADER MACHINE WORKS

210 N. Racine Ave. Chicago, Illinois

A new Wire Mill under construction in the State of Texas will install GLADER WIRE NAIL machines 100%.

The production figures on common nails shown below, are guaranteed.

SIZE MACH.	SIZE WIRE	MAX. LENGTH OF WIRE	NUMBER OF NAILS PER MIN.	CAP. IN POUNDS PER HR.
#00A	#16	1⅛"	700	37.2
#00	#14	1¼"	550	55
#0	#12	1¾"	450	89
#1	#10	2½"	400	192
#2	#8	3½"	325	310
#3	#4	5"	225	523
#4	#1	7"	190	622
#4s	5/16"	9"	175	1155
#5	⅜"	12"	160	2400

This high output and economical operation account for the GLADER machine being accepted as standard equipment in all recent installations.

'Round the World With the Wire Industry

Sweden

BECAUSE of war conditions, the potential export demand for Swedish commercial iron is practically unlimited, but the country's ability to export is contingent upon imports of coke pig iron, which it can now obtain only from Germany. In Sweden's trade agreement with Germany, large quantities of commercial iron were included, but transportation difficulties may considerably reduce delivery of the stipulated quantities.

✦ ✦ ✦

THE shortage of certain alloys, especially nickel and tungsten, is another problem the already harassed Swedish iron and steel industry must cope with. By joint effort, the industry has succeeded in lowering the content of these alloying metals, or substituting other metals of which there is a larger supply.

IN collaboration with the Price Control Board, steel mills have announced price reductions on certain commercial iron and steel products sold on the Swedish market. These reductions involve a cut in present quotations by approximately 7 to 10 per cent. Quotations on iron and steel manufactures are expected to drop as a result of this action.

✦ ✦ ✦

Rumania

THE iron industry, now controlled by Germany, includes eight blast furnaces, four of which are in operation. Two belong to the Resicza works and two to the State Iron Works in Hudorra, according to the foreign press. It is reported that the German authorities are to modernize the industry, and in order to make effective use of local low-grade iron ores it is proposed to erect four or five Krupp furnaces of 30,000 tons capacity each, all equipment to be supplied from Germany.

Switzerland

DRASTIC restrictions have been placed on the use of copper and copper alloys in Switzerland. The use of these metals is forbidden for outside wiring, roofs, drain pipes, water pipes, radiators, containers of all kinds, and for similar purposes.

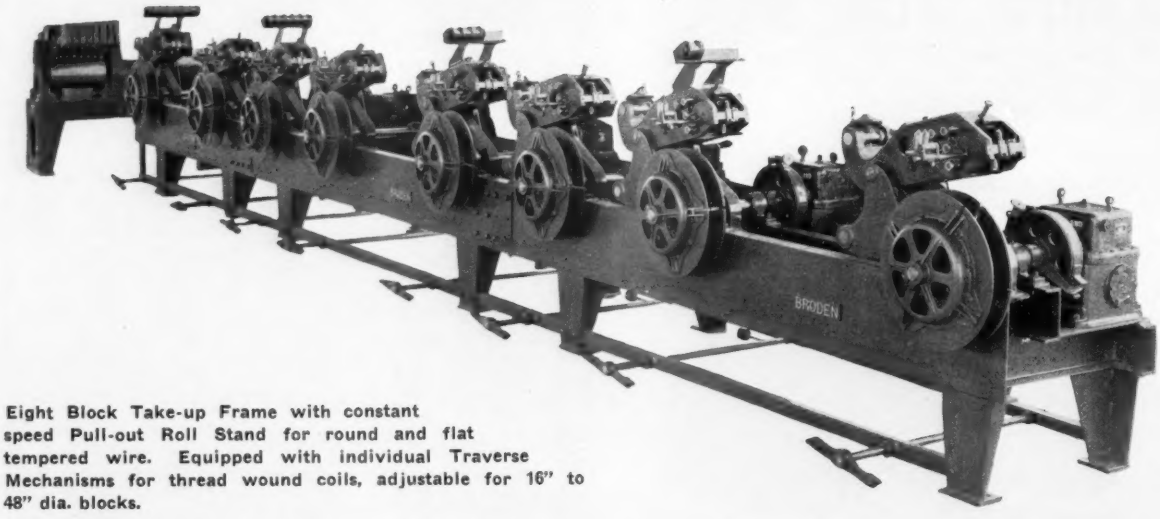
✦ ✦ ✦

FIRMS have been ordered to submit an inventory of their stocks of copper, zinc, bismuth, wolframite, aluminum, and magnesium in all forms, as well as waste and alloys of these metals. Objects of art and household industry, and trade articles are exempt.

✦ ✦ ✦

Hong Kong

STOCKS of iron and steel held in Hong Kong are reported to be low, with certain sizes of bars and sheets unobtainable only from the United States.



Eight Block Take-up Frame with constant speed Pull-out Roll Stand for round and flat tempered wire. Equipped with individual Traverse Mechanisms for thread wound coils, adjustable for 16" to 48" dia. blocks.

WIRE DRAWING MACHINES — SINGLE AND DOUBLE DECK — CONTINUOUS MULTI DRAFT. PATENTING — GALVANIZING — TINNING FRAMES. FINE WIRE SPOOLERS. WIRE FLATTENING MILLS — FILING AND EDGING MACHINES. SHEARS — SCALE BREAKERS — SCRAP BALLERS — NAIL GALVANIZING AND BLUEING EQUIPMENT.

THE BRODEN CONSTRUCTION COMPANY

Subsidiary of The Wean Engineering Co.
22800 Lakeland Blvd., Cleveland, O.
ENGINEERS & BUILDERS

THE colony's principal user of iron and steel is the shipbuilding industry. In addition to the construction of ocean-going vessels, Hong Kong's repair and drydocking facilities, local construction industry, and a number of small factories, use substantial quantities of iron and steel. There is no local production, the colony's entire consumption of iron and steel products being imported. High-grade tool steels and sheets of various sizes and qualities are in demand.

✦ ✦ ✦

DESPITE a probable reduction in industrial construction, the Hong Kong iron and steel trade anticipates greater imports during the remainder of 1941, because of activity in local shipyards and plans for enlarging facilities to permit construction of several additional freighters. Considering practical cessation of Australian iron and steel imports, it seems probable that the United States will be almost the sole supplier to this market in coming months.

✦ ✦ ✦

EFFECTIVE May 14, 1941, the importation of iron and steel products into Hong Kong was prohibited except by import license. Orders already placed with American suppliers were not affected by the order.

✦ ✦ ✦

Brazil

THE Companhia Siderurgica Belgo-Mineria operates two steel plants in Brazil, one at Siderurgica a Sabara and one at Monlevade.

✦ ✦ ✦

THE plant at Sabara has in operation two blast furnaces with an annual production capacity of 26,000 metric tons, three basic open-hearth furnaces with a total annual capacity of 36,000 tons of steel ingots, and one rolling mill. The output of the Sabara plant is estimated at about 36,000 tons of round, flat, angle, and square iron, with a minimum section of 3 inches.

✦ ✦ ✦

THE Monlevade plant consists of two 85-ton blast furnaces, with an annual pig-iron capacity of 50,000 tons; two 35-ton open hearths with an annual steel capacity of 55,000 tons; one 38-inch blooming mill; two continuous billet-heating furnaces; complete rolling mill for rods and wire; and one wire mill of 30,000-ton capacity which produces plain galvanized and barbed wire.

✦ ✦ ✦

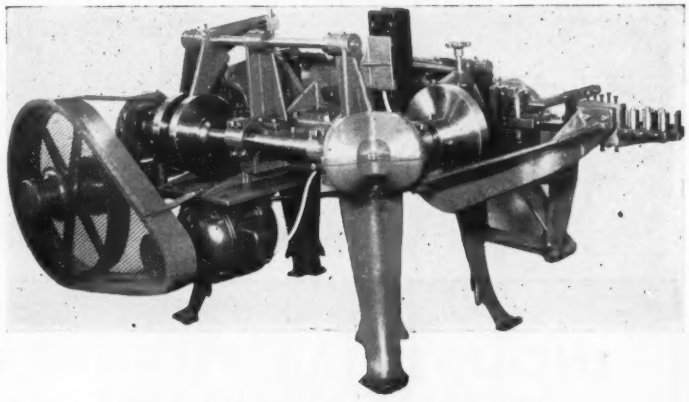
THE total future output of th Sabara and Monlevade plants will be about 190,000 metric tons —40,000 tons for the former and 150,000 for the latter.

Make Your Plans Now to Attend The Wire Association Meeting in October, 1941 at Hotel Philadelphian, Phila., Pa.

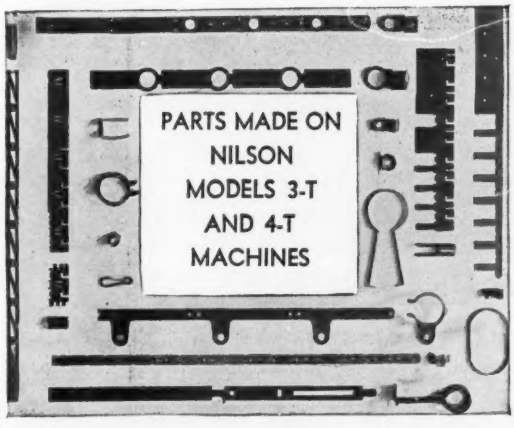
BRAZIL'S new steel plant, to cost $45,000,000 — partly financed by a loan of $20,000,000 by the Export-Import Bank of the United States—is to be located at Velta Redonda, State of Rio de Janeiro, and will be operated by the Siderurgica Nacional S. A. Ground has been broken for this plant.

NILSON AUTOMATIC PRESS AND FOUR SLIDE MACHINE

FOR SWAGING STAMPING PIERCING BLANKING FORMING OF COILED METAL



General Purpose, Heavy Duty Fabricating and Metal Forming Machine.



Machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc. Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses.

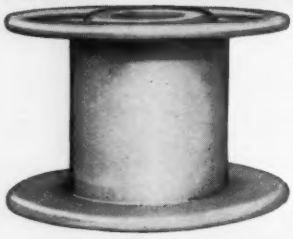
✦ ✦ ✦

For Complete Details Address

THE A. H. NILSON MACHINE CO.

BRIDGEPORT, CONN., U. S. A.

FOR HIGHEST SPEEDS

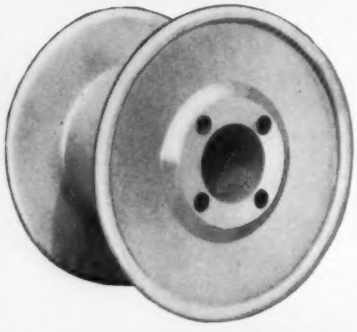


APCO MOSSBERG

PRECISION

STEEL REELS

The reels that are engineered to the job... designed and built by the company that originated the steel reel idea . . . are the reels you should be using in your plant. Every year, more and more Apco Mossberg Steel Reels are bought by quality-minded buyers throughout the wire industry.



FREE

ENGINEERING SERVICE

Without obligation to you, Apco Mossberg engineers will be glad to study your reel problem, and supply complete suggestions, drawings, blue prints. Write for information today.

REELS..SPOOLS..BOBBINS

APCO MOSSBERG COMPANY

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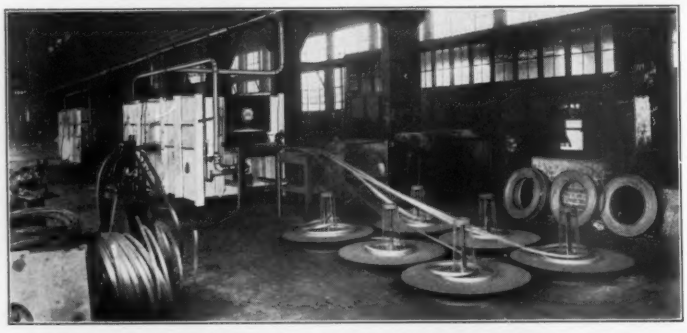

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Outstanding Personalities Of the Wire Industry

Foxboro Company Announces Additions To Personnel

THE Foxboro Company, Foxboro, Mass., has announced two additions to its personnel. **Elmer E. Forslind** has joined the New England office and **Paul T. Graff** has joined the staff as sales engineer. **William W. Nelson,** who has been a service engineer of the company has been transferred to the New England sales force.

✦ ✦ ✦

Fred W. Muller, Mgr., Insulation Dept., Armstrong Cork Company

SUCCEEDING **Alfred M. Ritts,** who has been made assistant manager of the newly-organized munitions division of the company, **Fred W. Muller,** since 1937 connected with Armstrong Cork Co., Lancaster, Pa., has been made manager of the company's high temperature insulation department.

✦ ✦ ✦

Edward Nelson Case, Research Staff, A. F. Holden Company

THE A. F. Holden Company of New Haven, Conn., recently announced the appointment of **Edward Nelson Case** to their research staff. Mr. Case is a recent graduate of Union College, Schenectady, N. Y. **James Ceriani,** formerly research chemist, E. I. duPont de Nemours & Co., Wilmington, Del., also has joined Holden's research staff. He is a graduate of the Royal Institute of Industrial Chemistry at Bergamo, Italy.

✦ ✦ ✦

Charles F. Hammond, Assistant to The President, the A. F. Holden Company

CHARLES F. HAMMOND, for twenty-two years Chief Metallurgist of the Winchester Repeating Arms Company and more recently Superintendent of the Cartridge Division, resigned to become Assistant to the President of the A. F. Holden Company, Manufacturers of Heat Treating Baths and Equipment, New Haven, Conn. In addition to this wide experi-

ence in ferrous and non-ferrous metallurgy, Mr. Hammond is a recognized authority on metallurgy pertaining to small arms and small arms ammunition, and is identified with the pioneering of the industrial use of Molybdenum high speed steels.

✦ ✦ ✦

American Steel & Wire Co. Announces Appointments

FOUR changes in engineering personnel at its Electric Cable Works in Worcester, Mass., are announced by American Steel & Wire Co., subsidiary of U. S. Steel Corp.

✦ ✦ ✦

SAMPSON O. MILLER has been appointed supervisor, engineering and research, while **Evald O. Wahlstrom** has been named to succeed him as transmission engineer. At the same time **Robert S. Horner** has been made products engineer and **Walter T. Pierce** has been appointed consulting electrical engineer.

✦ ✦ ✦

MR. MILLER has been associated with American Steel & Wire since 1940 in the capacity of transmission engineer.

✦ ✦ ✦

MR. HORNER first started with the company in 1928 as an engineer at South Works, Worcester, and held various positions before becoming an electrical engineer in the Electric Cable Works in July, 1939, which position he has held to the present time.

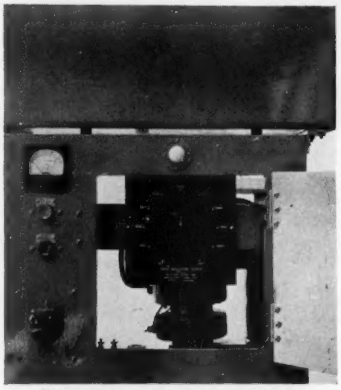
✦ ✦ ✦

STARTING as a draftsman in the tramway department at North Works, Worcester, in 1927, Mr. Wahlstrom was made electric cable engineer last November.

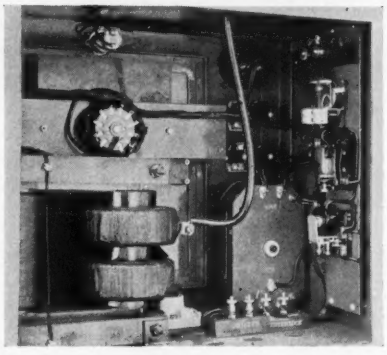
✦ ✦ ✦

MR. PIERCE was first employed by the Wire Company in 1922 as a tester and worked his way through various positions before becoming chief operating and development engineer at the Cable Works in November, 1939. He has held that position until his present appointment.

(*Please turn to Page 664*)



Front View (Shows Door Open)



Interior View

Sparker For Continuous Cure and Synthetic Extrusions Compounds

THIS APPARATUS WILL LOCATE DIELECTRIC FAULTS while the wire is being insulated. When breakdown occurs, the operator is notified by an audible alarm. A totalizing and resettable counter gives the number of faults in each reel and total faults per day. By sorting out the defective reels in this operation, the majority of the resparking is eliminated. Continuous range of voltage at the electrode is from two thousand to sixteen thousand kilovolts. The sparker is equipped with voltmeter reading in kilovolts, push button control and automatic interlock with the takeup motor.

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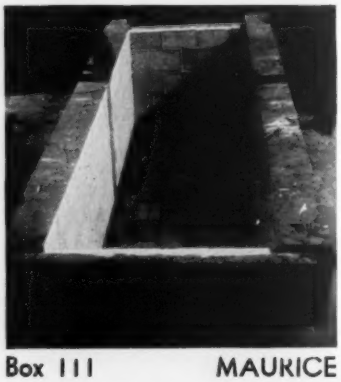

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Rusch Wire Die Corporation

275 Seventh Ave., New York, N. Y.

CARBIDE DIES AND TOOLS

Outstanding Personalities of the Wire Industry

(*Continued from Page 663*)

Promotions Announced by American Steel & Wire Company

EIGHT promotions in the operating department have been announced by American Steel & Wire Co., U. S. Steel Corp. subsidiary.

✦ ✦ ✦

J. P. DEBRI has been appointed superintendent of the Rockdale Works at Joliet, Ill., succeeding **Daniel Lynch,** who is retiring after 48 years of service with the company.

✦ ✦ ✦

AT Duluth, **F. J. Martin** has been named general superintendent of the company's works and **J. C. Witherspoon** has been made assistant general superintendent. Mr. Martin has been superintendent of the hot mills and finishing mills, while Mr. Witherspoon was superintendent of the steel works.

✦ ✦ ✦

ALFRED OSOLIN, master mechanic at Cuyahoga Works, Cleveland, has been appointed general master mechanic in the company's main office, while **Robert E. Cramer,** at present with the Donora, Pa., Works, has been appointed special engineer at the main office. **William Henry** of Cleveland has been appointed superintendent of engineering and maintenance at Donora Steel Works, succeeding Mr. Cramer, while **Axel H. Olson** has been appointed master mechanic at Cuyahoga Works to succeed Mr. Osolin. At the same time **Carl Rohrer** has been appointed general foreman of maintenance and construction at Cuyahoga Works.

✦ ✦ ✦

Detroit Rex Makes Changes

EFFECTIVE September 1st, 1941, **Mr. S. A. Harris** has been appointed Eastern Regional Manager.

✦ ✦ ✦

MR. W. F. NEWBERY, formerly Eastern Regional Manager, has been promoted to the General Office at Detroit on Special Duties.

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TRADE MARK REG. U.S. PAT. OFF.

Here is Chemical Equipment whose corrosion resistance does not depend on merely a surface lining . . . HAVEG is corrosion resistant throughout its entire mass. HAVEG is a strong, tough and durable molded plastic . . . impervious to rapid temperature changes . . . unaffected by temperatures up to 265° F. It is being successfully used in acetic acid service . . . hydrochloric . . . hydrofluoric . . . sulphuric up to 50% concentration.

Available as PIPING . . . VALVES . . . FITTINGS . . . FUME DUCT . . . TANKS . . . TOWERS . . . seamless, one piece units, as large as 9' diameter and 9' high.

HAVEG equipment and piping is available in a wide range of standard sizes . . . completely described in bulletin F29. Send for your copy today.

HAVEG CORP.
NEWARK, DELAWARE

Herbert N. Snowden, General Works Manager, Seneca Wire & Mfg. Company

THE Seneca Wire & Mfg. Company of Fostoria, Ohio, announces the employment of **Herbert N. Snowden** as General Works Manager of their plant, having charge of all production operations in all departments.

✦ ✦ ✦

MR. SNOWDEN was with the John A. Roebling's Sons Company of Trenton, New Jersey, for the past twenty years—for ten years serving as Superintendent of the wire mills in Roebling, N. J. following with the position of Assistant General Superintendent of all wire mills of the Roebling Company in both Roebling and Trenton, New Jersey.

✦ ✦ ✦

Peter Stewart

PETER STEWART, assistant manager of operations, Worcester, of American Steel & Wire Co., died suddenly at his home in Boylston, Mass., September 10th.

✦ ✦ ✦

BORN in Glasgow, Scotland, on September 25, 1875, Mr. Stewart came to this country with his parents at the age of 11. With the exception of one year spent in Philadelphia, Mr. Stewart's entire business experience has been in Worcester. He worked at the Warren Leather Goods Co. and the Worcester Corset Co. and served a year as reporter for the Worcester Telegram before becoming associated with American Steel & Wire as timekeeper at the Cable Works in July, 1900. In 1902 he was transferred to South Works as stock clerk and worked his way up to the superintendency of that plant before being made superintendent of North Works in February, 1925. Three years later he was transferred back to South as general superintendent, where he remained until appointed to his present position in December, 1939.

✦ ✦ ✦

MR. STEWART'S personal interests were many and varied. He is survived by his widow and seven children.

STEEL WIRE

By MAURICE BONZEL

✦ ✦ ✦

Translated and Published by

Kenneth B. Lewis

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✦ ✦ ✦

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495 pages—414 illustrations

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Applied Physical Metallurgy — Industrial Processing of Ferrous and Nonferrous Metals and Alloys

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570 Pages . . . 355 Illustrations . . . 6x9 . . . Red Cloth Bound

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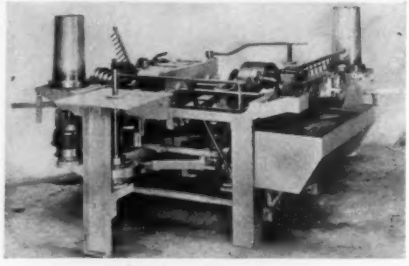

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Equipped with rewind attachment with drums up to 16" in diameter.

Also makers of other wire drawing machines, wire mill accessories such as straighteners, pointers and water cooled die holders, and special machinery.

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HIGH OR LOW CARBON WIRE, COLD HEADING,
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SPECIALLY ADAPTED FOR HIGH SPEED DRAWING MACHINES
BETTER FINISHED WIRE — LOWER DIE COSTS
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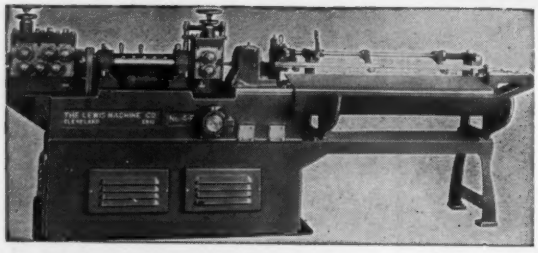
LEWIS TRAVEL-CUT WIRE STRAIGHTENING and CUTTING Machines



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WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

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Platinum Medal Award

Institute of Metals Honours Scientist

AT a general meeting of the Institute of Metals in Oxford on May 28, the President, (Lieut.-Colonel the Hon. R. M. Preston, D.S.O.), presented the 1941 Institute of Metals Medal to **Dr. C. H. Desch,** F.R.S. "for distinguished services to non-ferrous metallurgy".

✦ ✦ ✦

DR. DESCH, trained as an organic chemist, became Graham Young Lecturer in Metallurgical Chemistry in the University of Glasgow, and subsequently Professor of Metallurgy in the Royal Technical College, Glasgow, and the University of Sheffield, and Superintendent of the Metallurgy Department of the National Physical Laboratory. Since his retirement he has been Adviser to the Iron & Steel Research Council. His textbook on "Metallography" is now in its fourth edition.

✦ ✦ ✦

DR. DESCH is a past-president of the Institute of Metals and of the Faraday Society, and a vice-president and Bessemer Medallist of the Iron & Steel Institute.

✦ ✦ ✦

THE Medal, which is bestowed yearly without restrictions of race, creed or even membership of the Institute of Metals, has been offered to the Council of the Institute by the Mond Nickel Company, Ltd., for award as a premier distinction in the metallurgical world. It is of pure platinum, the medal having been prepared at the Company's refinery in London. A London artist, Mr. Harold Stabler, designed the medal, on the obverse of which is the bust of a female figure holding high a laurel wreath and round the outside is inscribed the words "AWARD OF THE INSTITUTE OF METALS". The design on the reverse symbolizes metallurgical research and consists of three inter-twined links. In the top link "Research" is represented by a microscope; the two lower links represent the directions research may take—"Science" symbolized by a wash-bottle and filter, and "Industry" by a factory building. On the surrounding border is the inscription — "FOR DISTIN-

GUISHED SERVICES TO NON-FERROUS METALLURGY". The name of the recipient is engraved around the edging of the platinum medal, a silver reproduction of which has been presented to the British Museum in London.

✦ ✦ ✦

THE first man to receive the Medal—in 1938—was **Sir William H. Bragg**—past-president of the Royal Society and director of the Royal Institution of Great Britain. Sir William Bragg is famous for his investigations in connection with the X-ray examination of metals as well as in many other fields of scientific research.

✦ ✦ ✦

THE second award of the Platinum Medal was made in 1939 to the late **Sir Harold Carpenter,** who held the unique distinction of having been president of all three of the great British metallurgical societies—the Institute of Metals, the Iron & Steel Institute and the Institution of Mining and Metallurgy. His work on corrosion and the production of large single crystals of metals is specially remembered as in his recent monumental book on metallurgy. At the time of his accidental death (while on a walking tour in Wales last year) he was professor of metallurgy at the Royal School of Mines, London, a position he had occupied for the past quarter of a century.

✦ ✦ ✦

THE third award of the medal, in 1940, to **Dr. Paul D. Merica,** was to an American citizen—and, incidentally, an old and valued member of the Institute of Metals, which has over 300 members in the U. S. A.—a particularly happy choice on the part of the Council, bearing in mind the increasingly close and helpful relations between Great Britain and the United States. The presentation was made, on behalf of the president, at the British Embassy, Washington, D. C., by Viscount Halifax, the British Ambassador to the United States.

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Reel capacity 350 lbs.

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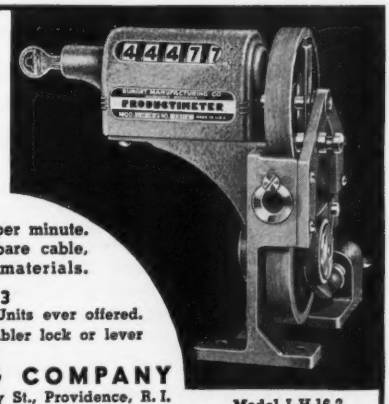

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Ratio of Apparent Civilian Demands to Supply After Defense Needs

ROBERT E. McCONNELL, Chief of O.P.M. Conservation and Substitution Section, estimated that after Army and Navy defense requirement are filled, the ratios of apparent civilian demands, or orders, to the remainder supply, as of July 1, are as follows:

✦ ✦ ✦

Aluminum (virgin and scrap) 15 to 1.
Copper 5 to 2.
Nickel 2 to 1.
Alloy steels 2 to 1.
Tungsten 2 to 1 (A).
Zinc 3 to 2.
Tin 3 to 2 (A).
Chromite 3 to 2 (A).
Manganese 3 to 2 (A).
Mercury 3 to 2 (A).
Plastics 3 to 2.
Nitrates 8 to 7.
Rubber 10 to 7 (A).
Power 10 to 9 (3 to 2 in SE).
Steel 10 to 9 (3 to 2 on plate, etc.)
Lead 1 to 1.

✦ ✦ ✦

(A) STRATEGIC imported materials in which government and industry stock piles are being created, and where in stock piles tonnage requirements are considered as defense requirements.

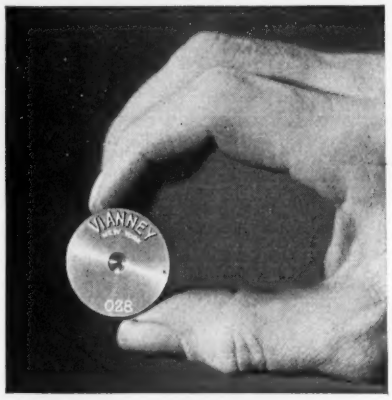
✦ ✦ ✦

New Immersion Tin Finish for Copper and Brass Surfaces

THE Alrose Chemical Company of Providence, R. I., announces BON WHITE, a new immersion tin finish, applicable to all copper and brass surfaces. BON WHITE may be applied in ten seconds and can, in many instances, replace slow boiling methods of tin plating. BON WHITE solution is prepared by dissolving sixteen ounces of sodium cyanide and six ounces of BON WHITE paste in one gallon of boiling water. When cooled to room temperature, no further heat is necessary and no adjustment is required, as the material is completely plated from the solution. The life of the solution depends on the production volume. Enamel and glass containers are used and the work can be handled in baskets or on wire. BON WHITE assures an inexpensive, highly-effective white finish and, being pure tin, offers considerable tarnish resistance. This new finish has already found wide acceptance in many industries.

VIANNEY

Famous Wire Drawing Diamond Dies



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Address
Richard E. Brown, Secretary
Stamford Trust Co. Bldg.
300 Main St. Stamford, Conn.

The Defense Supplies Rating Plan

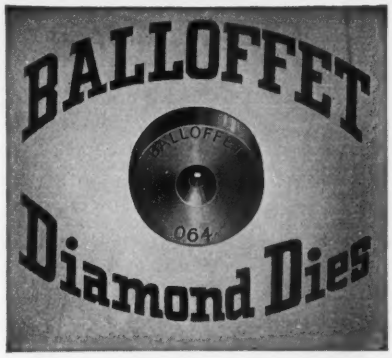
AT meetings recently held at Waterbury, Conn., and Cleveland, O., the details of the defense supplies rating plan were outlined and warning given to industry that unless it availed itself of the provisions of the plan developed in May and set up in the OPM Priority Division they may be unable to get steel and other materials needed for defense.

✦ ✦ ✦

HERE is how the plan operates: Under it business that qualifies as defense automatically receives a priority rating of A-10. This rating, however, does not interfere with orders carrying higher ratings. In order to obtain A-10 it is necessary to fill out the Priority Division's form P. D. 25. As the plan is intended only to protect those who now are having difficulty in obtaining materials and manufactured articles, it can be disregarded by those companies who now obtain such goods without difficulty.

✦ ✦ ✦

UNDER the plan those consumers who fill in the form are allowed to indicate the quantities of materials they will need for defense over the next quarter, so that they may receive their materials sufficiently in advance of actual consumption needs.



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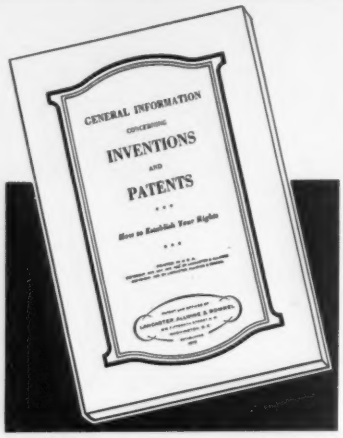

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Norton Co. Adopts Retirement Income Plan

NORTON COMPANY of Worcester, Mass., largest grinding wheel manufacturer and important producer of grinding machines, today announced adoption of a formal retirement income plan. This program will provide participating employes with a regular monthly income after retirement and in addition to benefits to which they are entitled under the Social Security Act.

✦ ✦ ✦

THE Norton Company has always believed in pensions and throughout its history has paid individual pensions to faithful older employes who were retired. Now, however, in view of the increase in the number of its employes, the company decided to institute a formal plan which will be unaffected by the uncertainties of business from year to year. A contract providing for retirement annuities for all eligible employes has been entered into with the John Hancock Mutual Life Insurance Company of Boston.

✦ ✦ ✦

MEMBERSHIP in the Norton retirement plan is voluntary. Each participating employe will contribute a small percentage of his monthly earnings. The company will not only match these contributions dollar for dollar, but will also provide, wholly at its own expense, contributions for past service. In this connection, older employes, who will have too few years of future service to build up an adequate retirement income from future contributions, will be provided by the company with additional monthly income in recognition of past service.

✦ ✦ ✦

BY joining the plan a Norton employe exchanges a small portion of his present income for a future income which may be expected to amount to several times its original cost to him. This is due to the fact that the company contributes a dollar for every dollar he invests in the plan and also contributes for his past service at its sole expense.

✦ ✦ ✦

THIS retirement income plan will affect all those of the 6,000 Norton employes who are between the ages of 30 and 65 and who have had 5 years' service with the company. Other present employes and new employes will be eligible to join the plan when the age and service requirements have been met. The plan is also being adopted by Norton's two subsidiary corporations — Behr-Manning Corporation of Troy, New York, and Norton Pike Company of Littleton, New Hampshire.

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Beryllium Copper Brush Spring Characteristics

MADE on special coiling equipment developed for small electrical applications beryllium copper springs have been found to have higher safe operating temperatures than bronze, music wire or stainless springs, more than twice the current carrying capacity of bronze and are supplied to the following tolerances in production quantities.

Length	1/32 inch
Outside Diameter	.003
Load Deflection	5%

✦ ✦ ✦

SPRINGS made of this alloy are said to be uniform in pitch and compressible to within ⅛ inch of solid length without the coils touching. Because the springs are sufficiently straight to roll easily across a flat surface, friction against brush-holder is reduced. Higher safe working stresses allow springs to be redesigned for greater free length thus reducing the change in brush pressure with brush wear. These beryllium copper brush springs are heat-treated for minimum drift and will maintain initial assembled tension without set.

✦ ✦ ✦

SPECIAL heat-treating routine results in such high conductivity as to eliminate the necessity for shunts or pigtails in many instances. Close tolerance on diameters assures firm and positive contact with carbon brush with an interference fit of only .005 to .008 inch.

✦ ✦ ✦

ENGINEERING design assistance, where springs of other alloys are to be replaced with beryllium copper, will be furnished by the Instrument Specialties Co., Inc., 249 Bergen Blvd., Little Falls, N. J., upon request.

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EST. 1917
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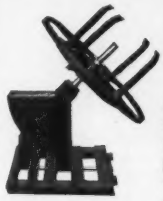
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Carl-Mayer Corp., The, Cleveland, Ohio

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Rahway, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

ANODES—Nickel
Seymour Mfg. Co., Seymour, Conn.

ANTI-RUST—Compound
National Oil Products Co., Harrison, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

AUTOMATIC SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

BAKERS—Hi-Speed
Carl-Mayer Corp., The, Cleveland, Ohio

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Carl-Mayer Corp., The, Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Morrison Engr. Corp., Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

BANBURY MIXERS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.

BARRELS—Air Blast
Dreisbach Engr. Corp., Yonkers, N. Y.

BERYLLIUM COPPER—Strip and Bars
Callite Tungsten Corp., Union City, N. J.

BLOCKERS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BORTZ—Diamond
Smit, J. K., & Sons, Inc., New York, N. Y.

BRICKS—Acid Proof
Keagler Brick Co., Steubenville, Ohio

CALIPERS—Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CASTINGS—Wire Mill
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., The, Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, Ohio
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corporation, Newark, Del.
Morgan Construction Co., Worcester, Mass.
Nukem Products Corporation, Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

CLOTH—Wire, All Metals
Callite Tungsten Corp., Union City, N. J.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.
National Oil Products Co., Harrison, N. J.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, Ohio
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

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Ajax Manufacturing Co., Cleveland, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Wire Drawing
National Oil Products Co., Harrison, N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

COPPER—Electrolytic
Scomet Engineering Co., The, New York, N. Y.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUSTOM WIRE DRAWING—
Hy-Carbo Steel Co., Lowell, Mass.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIAMONDS—Industrial
Callite Tungsten Corp., Union City, N. J.

DIAMOND POWDERS—
Rusch Wire Die Corp., New York, N. Y.
Smit, J. K., & Sons, Inc., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
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Michigan Wire Die Co., Detroit, Mich.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Jersey City, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
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Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Inc., Jersey City, N. J.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Jersey City, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod & Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Michigan Wire Die Co., Detroit, Mich.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Michigan Wire Die Co., Detroit, Mich.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIRECT ELECTRIC RESISTANCE HEAT TREATING—
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Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, Ohio

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn.
Entwistle, James L., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FLASH BAKER—
Carl-Mayer Corp., The, Cleveland, Ohio
Morrison Engr. Corp., Cleveland, Ohio

FLUX—Galvanizing
Dewey & Almy Chemical Co., Cambridge, Mass.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
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FURNACES—Annealing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Holden, A. F., Co., New Haven, Conn.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

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Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

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Electric Furnace Co., Salem, Ohio
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Surface Combustion Corp., Toledo, Ohio
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Rockwell, W. S., Co., New York, N. Y.
Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., Cleveland, Ohio

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Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., Cleveland, Ohio

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Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion Corp., Toledo, Ohio

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FURNACES—Salt Bath
Electric Furnace Co., Salem, Ohio
Holden, A. F., Co., New Haven, Conn.
Surface Combustion Corp., Toledo, Ohio

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Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

GALVANIZING EQUIPMENT—
Meaker Co., The, Chicago, Ill.
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Farrel-Birmingham Co., Inc., Ansonia, Conn.

GEARS—Continuous Tooth Herringbone
Farrel-Birmingham Co., Inc., Ansonia, Conn.

GEARS—Wire Mill
Farrel-Birmingham Co., Inc., Ansonia, Conn.

GRINDERS—Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Norton Co., Worcester, Mass.

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Carl-Mayer Corp., The, Cleveland, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
National Oil Products Co., Harrison, N. J.
Parkin, Wm. M., Co., The, Pittsburgh, Pa.

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Entwistle, James L., Pawtucket, R. I.

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National Annealing Box Co., Washington, Penna.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—
Warner Company, The, Bellefonte, Pa.

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Dewey & Almy Chemical Co., Cambridge, Mass.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
National Oil Products Co., Harrison, N. J.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
National Oil Products Co., Harrison, N. J.
Oakite Products, Inc., New York, N. Y.
Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Coilers
Broden Construction Co., Cleveland, Ohio
Entwistle, James L., Pawtucket, R. I.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading with Wire Drawing Attachment
Ajax Manufacturing Co., The, Cleveland, O.

MACHINERY—Copper Wire Drawing and Rolling
Cook, John, Engr. Co., Paterson, N. J.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Ajax Manufacturing Co., The, Cleveland, O.
Broden Construction Co., Cleveland, Ohio
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Schuyler, W. A., New York, N. Y.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY—Draw Benches
Ajax Manufacturing Co., The, Cleveland, O.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Schuyler, W. A., New York, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, Ohio
Meaker Co., The, Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Grinding, Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Davis, R. L., Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Paper Covering Wire
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Pointing
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Superior Tool & Mfg. Co., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, Ohio
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

WHERE TO BUY, Continued

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, Ohio
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Bonwitt, Eric, Akron, Ohio (Used)
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Emory, Robert J., Co., Newark, N. J.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co,, Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Superior Tool & Mfg. Co., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Emory, Robert J., Co., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Ajax Manufacturing Co., The, Cleveland, O.
Broden Construction Co., Cleveland, Ohio
Hallden Machine Co., The, Thomaston, Conn.
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Schuyler, W. A., New York, N. Y.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Superior Tool & Mfg. Co., Worcester, Mass.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Davis, R. L., Electric Co., Wallingford, Conn.

MACHINERY—Testing Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
Shuster, F. B., Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Ajax Manufacturing Co., The, Cleveland, O.
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Cook, John, Engr. Co., Paterson, N. J.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Schuyler, W. A., New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Superior Tool & Mfg. Co., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MACHINERY—Wrapping Wire
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

METAL CLEANING—Dry Process
Dreisbach Engr. Corp., Yonkers, N. Y.

MILLS—Metal Reclaiming
Dreisbach Engr. Corp., Yonkers, N. Y.

MILLS—Rod, Bar, etc.
Farrel-Birmingham Co., Inc., Ansonia, Conn.

MILLS—Strip, Hot and Cold for Iron, Steel, Copper, Brass, etc.
Farrel-Birmingham Co., Inc., Ansonia, Conn.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., The, Seymour, Conn.

OILS—Wire Drawing
National Oil Products Co., Harrison, N. J.
Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Inc., Newark, N. J.

PAPER—Insulating
Manning, John A., Paper Co., Troy, N. Y.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
National Oil Products Co., Harrison, N. J.
Parkin, Wm. M., Co., The, Pittsburgh, Pa.

PICKLING TANK LININGS—
Keagler Brick Co., Steubenville, Ohio

PIPING AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.
Knight, Maurice A., Akron, Ohio

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Richards, G. Whitfield, Philadelphia, Pa.

PRESSES—Hydraulic and Mechanical
Bonwitt, Eric, Akron, Ohio (Used)
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

RECORDERS—Fault and Reel
Entwistle, James L., Pawtucket, R. I.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Moslo Machinery, Inc., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.

WHERE TO BUY, Continued

Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio
Morrison Engr. Corp., Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

RODS—Wire—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., The, Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wheeling Steel Corp., Wheeling, W. Va.

ROLLS—Iron, Steel, Alloy
Farrel-Birmingham Co., Inc., Ansonia, Conn.

ROLLS—For Strip, Rod, Bar Mills
Farrel-Birmingham Co., Inc., Ansonia, Conn.

ROLL STRAIGHTENERS—
Moslo Machinery, Inc., Cleveland, Ohio

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corp., Lawrence, Mass.

RUST REMOVING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Wheeling Steel Corp., Wheeling, W. Va.

SOAPS—Industrial and Wire Drawing
National Oil Products Co., Harrison, N. J.
Standard Industrial Compounds Co., Chicago, Ill.

SOLDER—
Kester Solder Co., Chicago, Ill.

SPARK TESTING EQUIPMENT—
Entwistle, James L. Pawtucket, R. I.

SPOOLS—Annealing and Wire Drawing
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hayward, R. B., Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., The, Seymour, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Seneca Wire & Mfg. Co., The, Fostoria, O.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TAKE-UPS FOR CABLE, HOSE, LEAD PRESSES AND SHEET RUBBER—
Entwistle, James L., Pawtucket, R. I.

TANK LININGS—Brick
Keagler Brick Co., Steubenville, Ohio.
Knight, Maurice A., Akron, Ohio

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.
Knight, Maurice A., Akron, Ohio

TANKS—Rubber Lined
Knight, Maurice A., Akron, Ohio

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—Friction and Power Driven
Standard Machinery Co., Providence, R. I.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.
Knight, Maurice A., Akron, Ohio

VULCANIZERS—
Bonwitt, Eric, Akron, Ohio (Used)
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Micro Products Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Universal Power Corp., Cleveland, Ohio

WELDERS—Butt Welding Attachment for Spot
Universal Power Corp., Cleveland, Ohio

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wheeling Steel Corp., Wheeling, W. Va.

WIRE DRAWING—High Grade Custom
Hy-Carbo Steel Co., Lowell, Mass.

WIRE—Electric
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., The, Seymour, Conn.

WIRE—Enameled for Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE-MANUFACTURERS—
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Seneca Wire & Mfg. Co., The, Fostoria, O.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Co., Spencer, Mass.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Bros., Inc., Cortland, N. Y.

WIRE—Nickel Silver and Phosphor Bronze
American Brass Co., The, Waterbury, Conn.
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., The, Seymour, Conn.

WIRE—Non-Ferrous to Specification for Special Purposes
American Brass Co., The, Waterbury, Conn.
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., The, Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE SOLDER—
Kester Solder Co., Chicago, Ill.

WIRE—Spring
American Brass Co., The, Waterbury, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Seneca Wire & Mfg. Co., The, Fostoria, O.
Seymour Mfg. Co., The, Seymour, Conn.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Stainless Steel
Callite Tungsten Corp., Union City, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Spencer Wire Co., Spencer, Mass.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Seneca Wire & Mfg. Co., The, Fostoria, O.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Co., Spencer, Mass.
Wheeling Steel Corp., Wheeling, W. Va.
Wickwire Bros., Inc., Cortland, N. Y.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

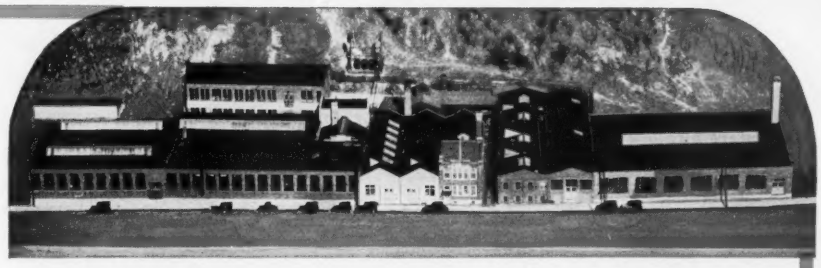
WRAPPING PAPER—Creped
Crepe-Kraft Co., Inc., Newark, N. J.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

HUDCO

SPECIALIZES

WINCO



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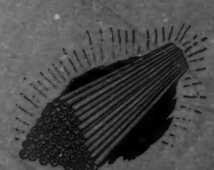

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